THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 46. Thursday, January 28, 1932. No. 806.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of
THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.
Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

FEBRUARY 4.

Institute of Metals (Birmingham Local Section):—Ordinary meeting. "The Dilatometer in the Study of Steels," Paper by N. P. Allen, M.Met.

FEBRUARY 8.

Institute of Metals (Scottish Local Section):—Ordinary meeting at Glasgow. "Aluminium-Silicon Alloys: Their Properties and Some Applications," Paper by R. B. Deeley, B.Sc.

Institute of British Foundrymen.

FEBRUARY 4.

Birmingham, Coventry and West Midlands Branch:—Ordinary meeting at Birmingham. "Modern Methods of Enamelling Cast Iron," Paper by J. H. D. Bradshaw.

FEBRUARY 6.

Wales and Monmouth Branch:—Ordinary meeting at Newport. "Black Sand," Paper by B. Hird.

An *Industry* at Last.

The reproduction elsewhere in this issue of a section of the Board of Trade Census of Production for 1930 gives the official *caché* to foundry activities as an integral industry so far as iron and steel are concerned. We have long sought and worked for such a desirable end. Obviously, in its train it has brought a certain amount of confusion, because for one thing it is not all-embracing. It only covers the larger establishments, leaving some 2,000 odd out of consideration. The most striking discrepancy is in connection with the steel-foundry section. No tonnage is yet available, but the value of the output is £797,000. In 1930, according to the National Federation of Iron and Steel Manufacturers, this branch of the industry manufactured 177,300 tons of castings, or only £4 odd a ton! Mr. Hemming, elsewhere, calls attention to this problem. We half imagine that manganese steel must have been included in the Federation's figures and omitted from the Board of Trade census, or perhaps dealt with as alloy steel. There does seem to be every chance, however, of the situation being clarified.

A surprising factor of the Census of Production is the complete absence of any reference to the malleable section, whilst the comparatively small business of pianoforte frames centred in less than half-a-dozen foundries is scheduled. We are not criticising the Board of Trade's effort in the slightest, because they have not the advantage of consulting with an employers' federation covering the whole industry. We offer them the suggestion that they would help foundry owners by following the principles we have followed in our Annual Review Number, that is, to divide the ferrous-foundry industry into steel, general engineering, marine, pipe, agricultural, railway, light or builders' castings; automobile; castings for the heavy iron and steel works; mining, printing, malleable and alloyed cast iron. As it is they have scheduled a matter of five and a-quarter million pounds worth of iron castings of no special type made by some of the 767 foundries particularised. It is a matter of satisfaction to us that our published estimates of the importance of the foundry industry have in general been amply confirmed.

A Paper "Wangle."

One of the most interesting phases of cupola costing is the price which should be debited for returned scrap. It has come to our knowledge that a certain amount of self-deception takes place in the direction of using an extremely low price as a costing figure for domestic scrap. This obviously has the effect of reducing the "cost-of-metal-at-the-spout" figure fictitiously. Moreover, as more and more domestic scrap is used, so does this basically important costing index become progressively lower. Where low-priced domestic scrap is used, there is obviously a tendency to use larger runners and risers than are strictly necessary; to melt more metal than is required and to be less careful in the employment of methods of moulding.

The question obviously arises as to what is the correct figure to use. It is easy for a foundry executive to insist that its value is that which the scrap merchant will pay the foundry for taking it away, but this does not satisfy us as being either reasonable or equitable. Then one could argue that, if this figure does not satisfy, one must substitute the price the foundry would have to pay if it ran short of domestic scrap. This is much better, but as domestic scrap is something of a known entity, it is worth a little more than the market price asked for like material. Thus we feel that, in order to exclude any possibility of self-deception, one should add 10 per cent. to the market price, and, if many scrap castings are included in the returns, they should have some slight credit. We are convinced that any attempt to cheapen the cost of metal at the spout or in the ladle by using absurdly low figures as the price of returned scrap is a fallacy, which should not be permitted in any well-conducted foundry. Put simply, it is an impossibility to compute a true profit-and-loss account when using a figure which puts a premium on bad foundry practice. Then taking the problem to an *ab absurdum* conclusion, a foundry, by amassing a fair quantity of its best scrap and by debiting it at 10s. per ton, could run through a charge and say its cost at the spout was 10s. a ton, plus the normal costs for coke, limestone, labour, etc. The costing department receiving such figures would then be able, on paper, to undercut everybody in the trade.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

More Customs of the Trade.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—At a meeting of my Executive Board, held to-day, it was reported that an article had appeared in an issue of your JOURNAL under the heading of "More Customs of the Trade," stating that it was the practice for members of the foundry trade industry to insure against fire, customers' patterns. I have been desired by my Executive Board to state that it is not a general custom of the trade to do this.—Yours, etc.,

J. A. S. HASSAL,
Secretary.

The National Ironfounding
Employers' Federation, 1st Floor,
India Buildings, Water Street,
Liverpool.
January 15, 1932.

Steel Castings Production.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your recent issue I read an article by Mr. J. Deschamps on the British Steel Foundry Industry in 1931. Whilst I agree with his outlook, I cannot allow his quoted figures to pass without comment. He quotes the production of steel castings in the United Kingdom for the past five years as ranging from 163,000 tons in 1927 to 127,000 tons in 1931. These figures are not steel-casting figures at all, but the molten steel produced in the steel foundry industry. The actual production of steel castings will be between 50 to 60 per cent. of the figures quoted by Mr. Deschamps, so that it is very evident that there is far more need for improvement than he suggests from the general examination of the figures.

I might mention that steel founders in general, and in many cases consumers also, are apt to think in terms of tons. What is really necessary is for the trade to think in terms of labour-hours, because, gradually, due to the vast improvement in their production, very much lighter castings are being used to attain the same end, and as the castings become lighter, it is obvious that more labour is necessary proportionate to the tonnage produced.

Costs formed on this basis will ultimately set the steelfounder's house in order.—Yours, etc.,

F. J. HEMMING,
Managing Director,
F. H. Lloyd & Company, Limited.
James Bridge Steel Works,
Near Wednesbury.
January 19, 1932.

[The figures which were included in Mr. Deschamps' article were inserted by us from statistics kindly supplied by the National Federation of Iron and Steel Manufacturers. In a personal letter to us, Mr. G. Ernest Wells also suggests that the Federation's figures are for molten steel for castings and not for finished castings.—EDITOR.]

MAJOR JOHN COLVILLE, M.P., Secretary of the Department of Overseas Trade, announces the following appointments in respect of the Overseas Trade Development Council:—Council: Sir James Lithgow, President of the Federation of British Industries; Mr. Eugene Ramsden, M.P., Director of Messrs. A. & S. Henry & Company, Limited. Advisory Panel: Mr. Victor Watlington, chairman of the Council of the British Electrical and Allied Manufacturers' Association, director of the English Electric Company, Limited. Mr. Louis Beale relinquishes the appointment of Special Commissioner to the Council in order to take up an official appointment in China. Mr. Arthur Mullins, secretary to the Council, is appointed Commissioner. Mr. C. M. Pickthall, assistant secretary, is appointed secretary.

Death of Mr. H. C. Dews.

We sincerely regret to announce the death of Mr. H. C. Dews, metallurgist to Messrs. Dewrance & Company, of Great Dover Street, London, and President of the London Branch of the Institute of British Foundrymen. Mr. Dews was taken ill the week before last with influenza, complications supervened and he passed away last Saturday. Though Mr. Dews was only 33, he had already achieved great prominence in foundry circles and was regarded as having a brilliant future. A native of Wakefield, he received his metallurgical training at Shemeld University. He was several years employed at Messrs. J. Hopkinson & Company, Limited, of Huddersfield, as metallurgical chemist. In 1925 he was appointed to his present position as chief metallurgist to Messrs. Dewrance & Company. He was a most active member of both the Institute of British Foundrymen, the Institute of Metals and the British Cast Iron Research Association. In connection with the first Institute he was a member of the Council and President of the London Section. In many respects he was a typical Yorkshireman, who, when he held definite constructive views was never afraid to express them in clear and incisive language. He was a regular contributor of Papers to the technical associations and Press, and was responsible for an Exchange Paper presented on behalf of the Institute of British Foundrymen to the French Association in 1929, it falling to our lot to present a synopsis. He had just recently taken over the leadership of the Non-Ferrous Sub-Committee of the Institute and only last Saturday week presented an excellent report as to its activities. His energy was astounding, for in the midst of his great activities he found time to write a book which is now regarded as the standard work on the subject on the Metallurgy of Bronze.

THE LATE MR. H. C. DEWS.

His last literary effort was the brilliant article on "Recent Developments in the Non-ferrous Foundry Industry" which he contributed to our Annual Review Number. On behalf of his numerous friends in the foundry industry we extend deepest sympathy to Mrs. Dews and his two children and also to Sir John Dewrance, K.B.E., and the staff at Great Dover Street, of which he was so popular a member.

Random Shots.

"Marksman" toddled down to Fleet Street a few days ago to inspect a painting of the Sydney Harbour Bridge, which Messrs. Dorman, Long & Company were displaying in the window of one of the Northern newspapers. This painting, you may remember, was hung at the Royal Academy last year. What he particularly liked about it was that one could see it was a bridge as soon as one looked at it. In some of these modern paintings you never quite know what you are looking at until you have either consulted the catalogue or made an unfortunate *faux pas* and suffered indignant correction from One Who Knows. And they are all very superior, sarcastic people, these Ones Who Know.

* * *

I made comment some while ago on the introduction of music into shops where repetition work is carried out. I even advocated it for the foundry, but the Editor reminded me of the existence of jar rammers which, in themselves, are sources of sweet music (if you like your music like that). The idea, however, does seem to be finding an increasing application, and I read now of a firm of cigarette manufacturers who have installed gramophones in their workshops, with beneficial results. The obstacle of a similar installation in the foundry is that nothing softer than a cinema organ could be heard over the racket. And cinema organs, perhaps fortunately, are very expensive things!

* * *

A commercial traveller, according to the latest definition, is a man who spends his firm's time and money trying to convince barmaids what a misunderstood man he is!

* * *

One or two stories have reached my ears lately which possibly you have not already heard. One concerns a very old "lizzy" chugging its way through the West End. The engine expired just as the car had reached a parking area. A uniformed attendant appeared from nowhere.

"Two shillings," he said.

"Lumme, Bill," said the owner-driver to his mate, "we've sold it!"

* * *

There is, then, the publican who said that of all men he preferred the teetotaller. He was asked to explain his unusual choice. "Well," he said, "the light drinker is no help to business. He orders half a pint, sits down and remains there for an hour or more. The heavy drinker is no help. He drains glass after glass, makes himself thoroughly unpleasant, and often brings the police in to see what the disturbance is about. Now the teetotaller, he's no trouble at all. He comes round the back door, says 'A pint in a bottle,' pays his money and hops it!"

"MARKSMAN."

Publication Received.

Refractories Bulletin No. 1.—Issued by John G. Stein & Company, Limited, Bonnybridge, Scotland. The cover of this 4-page leaflet announces that this "Bulletin" is to be issued monthly, and if the others are as useful as the first they will, indeed, be welcomed by users of refractories. No better innovation could have been made than to give a series of definitions germane to the refractory industry.

The Influence of Shape in Tensile Test-Bars.

By A. C. Vivian, A.C.G.I.

Introduction.

The view is advanced in the following article that when cast iron is tested to destruction in tension, the apparent tensile strength obtained is influenced even more largely than is generally supposed by the shape of the test-piece. When test-pieces of large diameter are broken, the comparatively low strength yielded by the test is usually attributed to weak metal in the centre of the casting; but a critical examination of a number of test results, and in particular those published in THE FOUNDRY TRADE JOURNAL of January 30, 1930, forces the conclusion that the apparent weakness is, to a considerable extent, due to an entirely different cause. These test data are recorded under "Mass and Skin Effects in Cast Iron," by Dr. Swift,[1] and "High-Duty Cast Irons," by Mr. A. E. McRae Smith, M.A.[2]

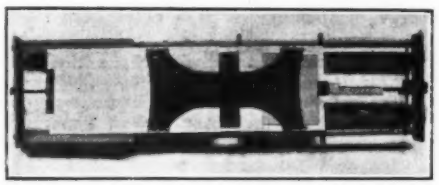

FIG. 1.—APPARATUS USED FOR RUBBER SHEET TESTS.

Acknowledgment is due for the very comprehensive information provided in these articles, which makes it possible to offer a reasonable explanation why Dr. Swift found that a ½-in. dia. bar had an ultimate tensile strength of 14 tons per sq. in. while a 3-in. dia. bar of precisely the same composition and melting conditions failed at 6½ tons per sq. in.

The explanation offered for the serious consideration of engineers is based on the consideration that when a tensile test-piece is pulled the load is applied to the skin of the test-piece and

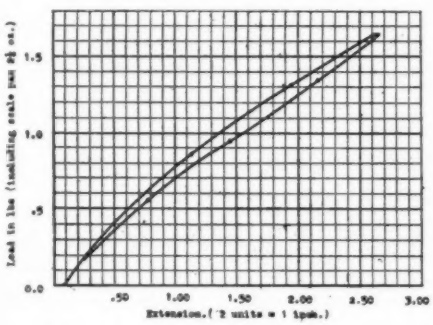

FIG. 2.—LOAD-EXTENSION GRAPH OF WEIGH-BAR.

is transmitted towards the centre of the section by a species of shear force. Since cast iron is not a perfectly rigid material the longitudinal fibres at the centre will not be stretched as much as the skin fibres, particularly if the specimen be relatively short and thick.

Probabilities.

Provided that the various parts of the specimen are long enough relative to their respective diameters, it is believed that this shear effect is negligible. But in spite of all that has been written on the influence of shape on tensile strength the opinion is advanced that the various parts of cast-iron tensile test-bars above ½ in. or ¾ in. dia. are not usually made long enough to eliminate shear effect and its serious consequences on the apparent ultimate tensile strength of cast iron.

It would appear that there are two main problems in connection with tests, one being the correlation of test results on bars of various sizes, and the other the correlation of test results with the strength of commercial castings. The article deals only with the first. It is thought, however, that a satisfactory solution of the first problem is an essential preliminary to a systematic attack on the second problem.

Doubts about Cast Iron.

If it could be shown by a series of simple tests that some of the baffling phenomena presented by the apparent variations in properties of cast iron (to which Mr. J. G. Pearce[3] refers) are really attributable to the test-piece and not to the material, a grave objection in the minds of many users to extending the use of cast iron might be removed.

Experimental Evidence.

The following experiments on thin rubber diaphragms were carried out to discover what might happen in tensile tests on short thick specimens. The apparatus used is shown in Fig. 1, and is extremely simple. It consists of a fixed table to which one end of the test-pieces were secured, and a sliding table to which the other ends were fixed. The sliding table was connected through a weigh-bar to a screw with a wing nut. A small pulley let into the fixed table, together with a scale pan and light cord connection, enabled the weigh-bar to be calibrated in position against dead-weight. The static friction of the sliding table was found to be equivalent to just under 2½-oz. dead-weight, but the effect of this friction was obviated during the tests by constantly tapping the apparatus.

The weigh-bar consisted of two strips of rubber sheet of the same material as was used for the tests, each ½ in. wide and rigidly secured with glue and adhesive tape to light metal plates, making a weigh-bar approximately 6 in. long overall and 4⅛ in. between grips. The method used for securing the rubber strips obviated shear effect across the width of the strips. The calibration curve is shown in Fig. 2.

The weigh-bar was found to be perfectly elastic, in the sense that, once a slight initial plastic yield had been removed by several loadings and unloadings, it always returned to its original length when the load was taken off. Like cast iron, there is no straight part in its elastic stress-strain diagram, and even more strikingly like cast iron, it exhibits an hysteresis effect. Care was therefore taken when measuring load through the weigh-bar to avoid errors, due to this backlash inside the material or hysteresis effect, by applying the load in increasing increments only, and not to overshoot the mark, or where this happened to start again.

Scope.

The test results are intended as an indication only. Rubber sheet was used because it stretches greatly with little load, and the distortions are in consequence clearly visible. The results are at best a gross exaggeration of what happens inside a short thick specimen of cast iron. They are not intended to be used quantitatively, but by using them qualitatively the mystery of the low apparent strength of cast iron of large cross-section is, in the writer's opinion, satisfactorily explained, and, if this explanation be accepted as being within the bounds of probability, they point the way to a series of straightforward tensile tests on cast iron which might have far-reaching effects.

Material Tested.

Red rubber sheet approximately 0.016 in. thick was used (20 thicknesses = 0.32 in.). Each section used is intended to represent a longitudinal section along the axis of a round bar. It must be admitted that since a flat rubber sheet is rectangular in cross-section, whereas a strictly comparable cross-section should be two isosceles triangles, apex to apex, the results obtained from the sheets present a distorted picture. Also, in the case of flat sheets, the cross-section of the enlarged ends varies as the width and not as the square of the width (*i.e.*, the square of

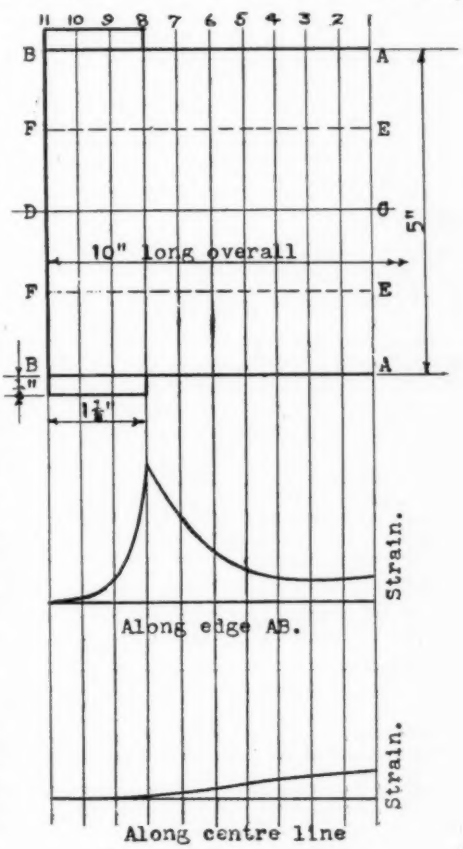

FIG. 3.—TEST SPECIMEN AND STRAIN DATA OBTAINED. (TEST NO. 1.)

the diameter of the round bar represented). The reasoning based on the results is not invalidated if these distortions are kept in mind.

Pieces of the sheet were glued at the edges to squared paper and marked off with thin lines in Indian ink and then cut out to size. Grips were reproduced with strong glued paper doubled over projecting pieces left on the rubber models. The glued grip paper was stiff enough relative to the rubber sheet to remain undistorted under the loads applied, in the tests. The sections were fastened to the fixed and sliding tables of the test apparatus by glass-headed pins pressed through the grips. Linear measurements on the specimens were made, using a scale (engine divided in 1/50th of an inch) read with the aid of a magnifying glass.

Test Results.

Test No. 1. Rubber section representing a test-bar 5 in. dia. by 10 in. long overall of constant cross-section throughout, with grips 1½ in. long. The sliding table was displaced 0.40 in.,

1 FOUNDRY TRADE JOURNAL, Vol. 42, Nos. 702 and 703.
2 *Ibid*, Vol. 42, Nos. 701, 702 and 703.
3 FOUNDRY TRADE JOURNAL, July 9, 1931, page 23.

0.70 in. and 1.00 in. successively, and measurements of length along edge and centre lines respectively were obtained. From these the strain at edge and centre were computed. All three sets of readings were quite consistent within the limits of accuracy of measurement used. A half-view of the test-piece and the strain results for a sliding-table displacement (*i.e.*, total stretch

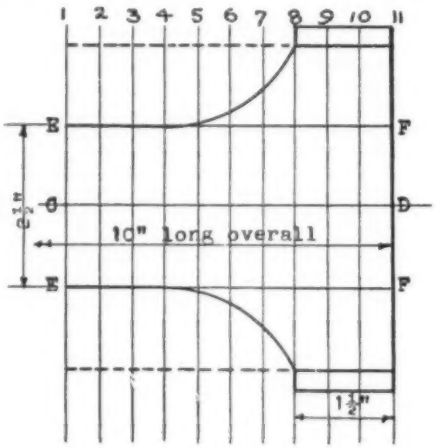

FIG. 4.—HALF-VIEW OF TEST SPECIMEN USED IN TEST NO. 2.

of test-piece between grips) of 0.70 in. are shown in Fig. 3.

Deductions from Test.—A concavity will be formed at the ends of short thick test-pieces when tested in an ordinary tensile test, and as a result there will be less strain along the centre fibres than along the skin fibres. Assuming that stress is some function of the strain, where there is a high strain there will be a high stress, and the test shows that there will be a very high stress developed in the skin of the test-piece where it enters the grips. If the specimen is

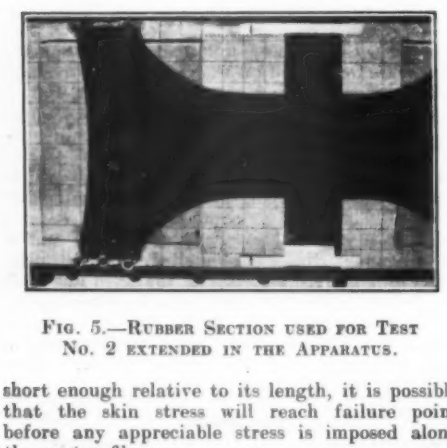

FIG. 5.—RUBBER SECTION USED FOR TEST NO. 2 EXTENDED IN THE APPARATUS.

short enough relative to its length, it is possible that the skin stress will reach failure point before any appreciable stress is imposed along the centre fibres.

The test result also confirms the fact that a plane cross-section at right angles to the axis at the mid-point of the test-piece will remain a plane section, and that plane sections on either side of the mid-point and equidistant therefrom will become curved surfaces identical in curvature but of opposite hand. Such surfaces become more and more curved, the farther they lie from the mid-point.

Test No. 2. Rubber section representing a test-piece 2½ in. dia. in parallel centre portion, with enlarged ends 5 in. dia. and 10 in. long overall, with grips 1½ in. long. The same test-

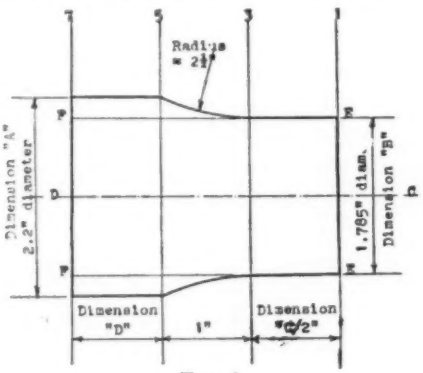

FIG. 6.

piece as used in Test No. 1 was ruled with additional lines EF shown in Fig. 3 and stretched by the same amount (0.70 in.) as in Test No. 1. Measurements of the lengths 1-4, 1-6, 1-8 and 1-11 shown in the figure were made before and after loading along the line EF and along the centre line CD. The specimen was then cut as shown in Fig. 4 and photographs, Figs. 1 and 5, and retested. Along the cut specimen the ratios of lengths measured along EF and CD respectively were found to be practically the same (under the stated loads) as similar measured ratios along the uncut specimen.

The load applied to the cut specimen was as nearly as possible equal to half the load of Test No. 1 and, in consequence, the mean stress across the mid-section was approximately the same in each case. On the cut specimen the sliding-table displacement was 0.62 in., as against 0.70 in. on the uncut specimen for the same stretch. The deflection of the mid-point of one of the ends of the test-piece was 0.20 in. for the cut specimen and 0.26 in. for the original specimen. The measurements made are recorded in Table 1.

Deductions from Test.—The experiments show why a reduced section test-bar tends to cause fracture at the reduced section in the parallel-gauge length. The ratio of skin and centre stresses is shown to be higher at Section 8 Fig. 4 than at Section 4. But the mean stress across the sections is in inverse proportion to the squares of the respective diameters. Thus, although there may be a far greater difference in stress between skin and centre near the grips than between skin and centre in the parallel portion, by proper proportioning of test-pieces for any particular material, the skin stress along the parallel portion may be greater than the skin stress near the grips.

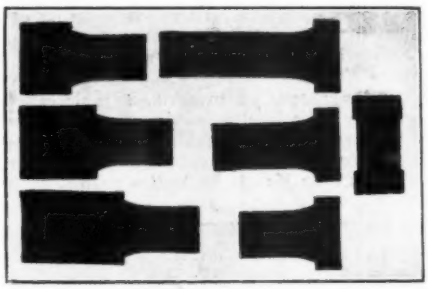

FIG. 7.—GROUP OF RUBBER SECTIONS USED FOR TESTS NOS. 3 AND 4. THE PARALLEL SECTION WAS USED TO CHECK THE STRETCH OF THE WEIGH-BAR.

It follows that in some cases the effect of increasing the apparent strength of cast iron by machining away the outside may fairly be attributed, not to the flaws and dirt which the strong close-grained material near the skin (as cast) may be presumed to contain but to the resulting levelling up of the stress-distribution across the parallel portion and a reduction of means stress across the enlarged ends. This view is supported by the results recorded later under Test No. 4.

Test No. 3.—Four rubber specimens of the dimensions stated in Fig. 6 and with dimensions C/2=1 in., throughout and dimension D=1 in., 2 in., 3 in. and 4 in. respectively.

The test specimens used in this and in the succeeding tests are shown in a group in Fig. 7. Based on one of the conclusions reached from Test No. 1 it was held that little error would be occasioned by using half-sections for these tests. The lines representing mid-sections were easily maintained as straight lines by the use of the stiff grip paper.

TABLE I.—*Results of Test No. 2.*

Stretch of test-bar in in.	Load. Scale reading.	Load. Lbs.	Deflection. In.	Measurements along line EF and centre line CD. 1—4.	1—6.	1—8.	1—11.	
0.00	0.12	0.00	Nil	1.51 1.51	2.51 2.51	3.52 3.52	5.02 5.01	Before and after cutting.
0.70	3.10	1.86	0.26	1.57 1.56	2.62 2.59	3.65 3.61	5.17 5.10	Before cutting.
0.62	1.33	0.93	0.20	1.57 1.56	2.64 2.61	3.68 3.63	5.18 5.13	After cutting.

NOTE.—In this and similar tables recording measurements along or near the edge and along the centre, the measurements along the centre are recorded immediately underneath the edge readings.

TABLE II.—*Results of Test No. 3.*

Dimension "D" in in.	Stretch of test-bar.	Load. Scale reading.	Load. Lbs.	Measurements along line EF and centre line CD. 1—3.	1—5.	1—7.	Deflection. In.
4	0.00	0.12	0.00	0.99 0.98	1.98 1.98	5.95 5.95	Nil.
4	0.35	2.85	1.72	1.13 1.12	2.27 2.22	6.30 6.29	0.01
3	0.00	0.12	0.00	1.00 1.00	2.00 2.00	5.00 5.00	Nil.
3	0.35	2.96	1.78	1.12 1.12	2.27 2.22	5.32 5.30	0.02
2	0.00	0.12	0.00	1.00 1.00	2.01 2.00	4.00 4.00	Nil.
2	0.35	2.60	1.64	1.13 1.12	2.27 2.22	4.32 4.27	0.06
1	0.00	0.12	0.00	1.00 1.00	2.01 2.01	3.00 3.00	Nil.
1	0.35	2.10	1.35	1.11 1.10	2.25 2.16	3.28 3.17	0.15

The specimens are full size scale models of longitudinal sections of Test-Bar L as specified in British Standard specification No. 321 (1928) for General Grey Iron Castings, but with dimension D varied as stated above.

The measurements obtained are stated in Table II. The sliding table of the test apparatus was displaced a constant amount in each of the four tests. The influence of extending grip length is at once apparent. When D=1 in. the load required to produce the stated stretch between the grips was 1.35 lbs. When D=4 in. the corresponding load was 1.73 lbs. At D=3 in. the load was slightly greater instead of being slightly less as expected. This discrepancy is attributed to having stretched the weigh-bar above its safe capacity, though it must be said that a re-calibration showed that it was not permanently affected in any way.

Deductions from test.—It is probable that if a number of C.I. test-bars of the dimensions stated are tested, an increase in the grip-length D above the standard amount of 1 in. will be found to have considerable influence in raising the apparent ultimate tensile strength up to some limit to be determined by test beyond which lengthening the grips would exhibit no appreciable advantage. It is likely that the relative dimensions at the grip ends of Test-Bar S in the specification above referred to, if applied to a test-bar of 1.785 in. dia. in its parallel portion (*i.e.*, the same as Test-Bar L), would result in an appreciable raising of the apparent strength of the large bar (if cast in a suitable form such that the depths of metal machined off the parallel portion of the standard L Bar and a revised L Bar with grip ends proportional to the grip ends on a standard S Bar, were made approximately the same).

Test No. 4.—Three rubber specimens of the dimensions stated in Fig. 6, but with dimension D=1 in. throughout and dimension C/2=1 in., 2 in. and 4 in. respectively.

The measurements obtained are given in Table III. In this case the load was kept constant at 1.35 lbs. and the corresponding displacement of the sliding table noted. The weigh-bar gives the relation between stress and strain and this was checked by testing a piece of width equal to dimension B in Fig. 6. The test-piece used is shown in Fig. 7. Weigh-bar and test-piece both yielded the same result, namely, that when dimension C/2 = 1 in. the stretch should be 0.12 in. for a load of 1.35 lbs. applied to the test-piece. Thus are the results obtained (Table III) when C/2 = 4 in. the sliding-table displacement should be 0.36 in. more than when C/2 = 1 in. Actually it was found to be 0.32 in. When C/2 = 2 in. the stretch was found to be 0.07 in. more than the stretch for C/2 = 1 in. instead of 0.12 in. more.

Thus as C/2 is decreased there is evidently a tendency for the stress across the parallel section to become less uniformly distributed. The same conclusion is suggested by an examination of the measured lengths 1-3, 1-5 and 1-7.

Deductions from Tests.—It would appear that the effect of lengthening C/2 is to make the stress distribution across the parallel portion of a test-bar more uniform. For obtaining values of ultimate strength of cast iron it may be found to be sufficiently accurate to obtain approximately uniform stress distribution at fracture by increasing the grip length D and leaving the parallel length C fairly short, since a considerable increase in the parallel length will render the machining of the specimens in a lathe impossible. But for obtaining true stress-strain values, it is clearly essential to make the parallel gauge length as long as practicable.

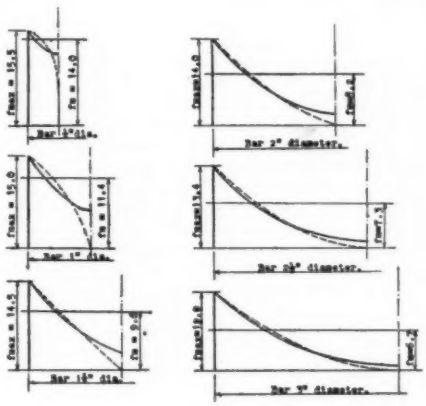

FIG. 8.

TABLE III.—*Results of Test No. 4.*

Dimension "C/2" in in.	Stretch of test-bar.	Load. Scale reading.	Load. Lbs.	Measurements along line EF and centre line CD. 1—3.	1—5.	1—7.	Deflection. In.
1	0.00	0.11	0.00	1.00	2.01	3.00	Nil.
				1.01	2.01	3.00	
1	0.35	2.12	1.38	1.12	2.27	3.29	0.14
				1.12	2.19	3.20	
2	0.00	0.10	0.00	2.00	3.01	4.01	Nil
				2.00	3.00	4.00	
2	0.42	2.12	1.38	2.22	3.33	4.36	0.12
				2.20	3.25	4.28	
1	0.00	0.10	0.00	4.00	5.00	6.00	Nil.
				4.00	5.00	6.00	
1	0.67	2.12	1.38	4.46	5.58	6.62	0.12
				4.45	5.51	6.53	

Analysis of Results on Cast-Iron Bars.

With the foregoing considerations in mind, the following analysis of Dr. Swift's results previously referred to is suggested as a basis for discussion.

Referring to Table IV, the figures stated in column 2 (ultimate tensile strength) have been read off the graph, Fig. 1, on page 79 of FOUNDRY TRADE JOURNAL, January 30, 1930. The figures in columns 3 and 4 (ultimate skin and centre stresses, respectively) are based on data in Mr. McRae Smith's Paper[4] and are hypothetical for this analysis. It should be possible, however, with the aid of a machine such as the Tensometer described in FOUNDRY TRADE JOURNAL of July 30, 1931, and by using a specially-designed test-piece for the purpose to obtain relatively correct values for ultimate skin stress and ultimate centre stress for various dias. of cast-iron bars. It should be pointed out that where the writer has used the term skin stress, the stress in the surface layers is implied whether the bar is machined or as cast when tested.

The centre stress values set out in Table IV are intended to represent the stress at which the centre fibres would fail, though it is considered unlikely that the whole bar would fracture if a small centre portion broke down. It has, however, been considered that the whole test-piece will fracture when the skin stress reaches its ultimate value at any point on the test-piece, since any localised failure would induce eccentric loading.

[4] FOUNDRY TRADE JOURNAL, January 30, 1930, page 84. Table I. Sample No. C-6. Test-bars 0.564 in. dia.

Stress Distribution.

Making use of the fundamental postulate that the total load across the section tested is equal to the ultimate tensile strength (*i.e.*, mean stress) multiplied by the cross-sectional area, the resultant stress distribution for each of the six bars scheduled in Table IV is shown in Fig. 8.

It has been assumed that each test-bar broke in its parallel length. It is not certain from the published report whether this was so or not, but with sufficiently enlarged ends it should be possible to ensure this.

TABLE IV.—*Schedule of Ultimate Strength, Ultimate Skin Strength and Ultimate Strength at the Centre of Cast-Iron Round Bars.*

1. Diameter of Bar.	2. Ultimate tensile strength.	3. Ultimate skin strength.	4. Ultimate strength at centre.
In.	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.
0	16.0	16.0	16.0
½	14.0	15.5	15.5
1	11.4	15.0	14.8
1½	9.6	14.5	13.7
2	8.2	14.0	12.0
2½	7.3	13.4	9.7
3	6.7	12.9	8.5

The theoretical stress lines shown dotted in the figures are derived from the following equation, which satisfies the fundamental postulate already stated :—

$$p.fm = k(r/R)^{2k-2}.fm$$

in which p = ratio of stress (at any point across the section at distance r from the centre) to the mean stress fm.
fm = mean stress = ultimate tensile strength of bar.
$fmax$ = ultimate skin stress.
r = distance measured from centre.
R = radius of bar.
and $k = fmax/fm$.

The probable stress distributions are indicated in the figures in full lines.

It must be emphasised that the above equation and resulting theoretical lines are used purely as falsework to provide a simple means of sketching in the probable stress distributions, just as shuttering is falsework in reinforced-concrete construction. The equation is intended to be a temporary expedient subject to amendment in the light of any further test results which may become available from time to time.

Corollary.

If the stress distributions shown in Fig. 8 are true in principle and if test-pieces of the same material (but designed to eliminate the shear effect described) are tested, the question of their breaking strength remains. The only satisfactory answer will be the positive one of actual tests. But meanwhile the writer would venture to offer the following line of reasoning. Confining consideration for the sake of brevity to a redesigned round bar of 3 in. dia. and assuming uniform stress across the whole section under a gradually increasing load, when the stress across the section reaches the ultimate centre stress value, in this particular case 8.5 tons per sq. in., the bar may fracture. But it is probable that fracture will not occur at this stage for the following reasons. The figure of 8.5 tons per sq. in. applies only to the material comprised within a cylinder of about ½ in. dia. (the centre stress figures stated in Table II are based on tests on bars of 0.564 in. dia.) at the centre of the bar or 3½ per cent. of the total cross-sectional area. There will in many cases be ample reserve of strength in the tougher material surrounding the centre to permit a sudden increase of stress

(*Concluded on page* 71.)

The Iron and Steel Foundry Industry.

For the first time in history the Board of Trade has taken cognisance of the foundry industry as a whole, at least so far as iron and steel are concerned. It should be noted, however, that the particulars given in the last issue of "The Board of Trade Journal," and reproduced below, relate to 767 establishments, whereas the new edition of "Ryland's Directory" will list approximately 3,000 foundries of this type.

Whilst not yet entirely satisfied with the figures now available, we regard this as recognition of our editorial efforts spread over the last ten years to fuse the various foundry trades into a vast industry, in order that the various units can co-operate for combating any adverse movement affecting their interests, either as an industry or a section.

Here is the report issued by the Board of Trade.

IRON AND STEEL FOUNDRIES.

Introductory.

Iron and steel foundries were grouped as a separate industry for the first time in the Census of 1930. In the previous Census the production of iron and steel castings was distributed between various metal-working industries, the chief of which were the heavy iron and steel trades, which covered the smelting and rolling of iron and steel and the founding of heavy castings, and the light-castings trade, which included machined products such as appliances for heating, sanitary and ventilating purposes as well as cast-iron stoves, grates, baths, etc. Many firms that manufactured engineering castings made returns on schedules for the engineering trades and the schedule for the hardware trade was used by some manufacturers of light castings. The manner in which output was classified in those schedules did not enable foundry production to be completely identified.

No general aggregates covering the range of products included within the scope of the schedule for iron and steel foundries can, therefore, be given for 1924, and the classification of output in that year only enables a reliable comparison of production to be made in the case of a limited number of products. In these circumstances the tables contained in this Report give particulars for the year 1930 only, but the paragraphs dealing with *production* furnish the 1924 figures in the case of those classes of goods for which the results obtained are believed to be reasonably complete.

The particulars given throughout this Report for the year 1930 relate to 767 establishments employing more than ten persons on the average during that year. Returns are outstanding from firms that employed, in 1924, about 2,500 persons, or 3 per cent. of the total number of employees shown in Table III.

TABLE I.

Iron castings.	1930. Quantity.	1930. Value.
Pipes and fittings :—	Th. tons.	£'000.
Up to 6 in. diameter and fittings therefor :—		
Soil pipes, drain pipes and rain-water pipes (including gutters of all sizes) and fittings therefor	135.8	2,012
Gas pipes and fittings therefor	29.9	283
Hot-water pipes (including radiators), and fittings therefor	15.5	250
Other water pipes (up to 6 in. dia.) and fittings therefor	53.2	458
Gas pipes and "other water pipes" and fittings, not separately distinguished	54.0	484
Pipes (up to 6 in. diameter) not specified above and fittings therefor	7.2	214
Pipes over 6 in. diameter and fittings therefor	203.7	1,567
Total—Pipes and fittings	499.3	5,268
Cast-iron stoves, grates and ranges for cooking and heating and loose parts therefor :—		
For coal and other solid fuel	95.4	2,711
For gas	66.4	3,695
For electricity	1.5	78
For liquid fuel	2.8	13
Total — Cast-iron stoves, grates, etc.	166.1	6,497
Cooking and washing boilers of cast iron (including portable boilers and furnace pans)	10.1	205
Sanitary cisterns (flushing tanks) of cast iron	10.8	323
Cast-iron baths (porcelain-enamelled or other finish)	19.5	586
Other sanitary cast-iron goods (sinks, basins, lavatories, etc.)	3.3	111
	*	20
Castings for roads and drainage (including manhole covers and frames)	39.0	416
Piano frames	—	81
Railway material (including railway spikes, sleepers, etc.) †	103.9	985
Engineering castings†	251.4	5,136
	*	138
Other castings and castings not separately distinguished† :—		
Iron	—	5,270
Steel	—	797
Total value—principal products	—	25,833

* Weight not stated.

† So far as returned on schedules for the iron and steel foundries trade.

Production.

Principal Products.—Table I shows the quantities and values of the chief kinds of products made at iron and steel foundries in 1930.

TABLE II.

Kind of goods.	Production.	Exports.	Net Imports.	Available for use in the United Kingdom.
1930.	Th. tons.	Th. tons.	Th. tons.	Th. tons.
Cast-iron tubes, pipes and fittings :—				
Up to 6 in. diameter	295.6	66.6	16.8	245.8
Over 6 in. diameter	203.7	49.6	3.7	157.8
Cast-iron stoves, grates and ranges for cooking and heating:				
For coal and other solid fuel	95.4	7.4	0.8	88.8
For gas	66.4	3.0	0.1	63.5
Cast-iron baths (porcelain-enamelled or other finish)	19.5	1.5	7.5	25.5
Castings for roads and drainage (including manhole covers and frames)	39.0	1.5	0.1	37.6
1924				
Cast-iron stoves, grates and ranges for cooking and heating :—				
For coal and other solid fuel	97.3	6.7	0.3	90.9
For gas	56.1	2.0	*	54.1
Cast-iron baths (porcelain-enamelled or other finish)	18.1	3.1	4.2	19.2

* Under 50 tons.

In addition to the output shown in the table, iron and steel scrap to the value of £45,000 was recorded as sold in 1930.

The total production in all trades in 1924 of certain of the main classes of goods shown above was as follows :—

Output in 1924.

	Th. tons.	£'000.
Cast tubes, pipes and fittings :—		
Weight stated	489.4	6,083
Weight not stated		1,166
Cast-iron stoves, grates and ranges for cooking and heating :—		
For coal and other solid fuel	97.3	3,307
For gas	56.1	3,154
Cast-iron baths (porcelain-enamelled or other finish)	18.1	756

Prices.—The average selling values in 1930 and 1924 of certain of the principal foundry products, as shown by the returns, were as follow :—

Kind of goods.	1930.	1924.	1930 as percentage 1924.
Cast-iron pipes and fittings :—	Per ton.	Per ton.	Per cent.
Up to 6 in. diameter	£12.5	£13.1*	95
Over 6 in. diameter	7.7	10.0*	77
Cast-iron stoves, grates and ranges for cooking and heating :—			
For coal and other solid fuel	28.4	34.0	84
For gas	55.6	56.2	99
Cast-iron baths (porcelain-enamelled or other finish)	30.1	41.8	72

* So far as returned separately for 1924.

Production, Exports and Retained Imports.—In Table II exports and imports of certain classes of foundry products in 1930 and 1924 are shown in relation to the quantities manufactured in the two years. The figures of production relate to Great Britain only, but they are probably comparable with those of imports and exports, which cover the United Kingdom, since no production of these goods was recorded for Northern Ireland in the 1924 Census.

Iron and Steel Structural Work, etc.—Firms that made their returns on schedules for the iron and steel (foundries) trades reported that they received £501,000 in respect of work done in 1930. This sum is made up as follows :—

	£'000.
Iron and steel structural work	305
General and jobbing engineering, etc.	158
Other work done for the trade, etc.	38
	501

Other Products.—The following particulars in respect of other goods made in 1930 were returned by firms that made their returns on schedules for the iron and steel (foundries) trades :—

	Value £'000.
Iron and steel forgings	28
Manufactures of non-ferrous metals (including scrap)	577
Other goods made	540
	1,145

Cost of Materials and Net Output.

The following figures show, for 1930, the total cost of materials used by firms that made returns on schedules for the iron and steel (foundries) trades, together with their net output and the amount paid to other firms for work given out to them :—

	1930 £'000.
Cost of materials used	11,426
Paid for work given out to other firms	160
Net output	15,938
	£
Net output per person employed	188

Employment.

Table III shows the average number of operatives and of administrative, technical and clerical staff employed in 1930 by firms that made returns on schedules for the iron and steel (foundries) trades. The distribution of the average number of operatives between males and females and between young persons and adults has been made on the basis of the proportions shown by the figures recorded in respect of the week ended October 18:—

TABLE III.

Average number.	Males.		Females.		Males and females.	
	Under 18.	All ages.	Under 18.	All ages.	Under 18.	All ages.
1930 Operatives (average for the year) ..	9,627	73,419	1,007	3,606	10,634	77,025
Administrative, etc. (as at October 18)	615	6,111	273	1,683	888	7,794
Total	10,242	79,530	1,280	5,289	11,522	84,819

Power.

Table IV shows, for 1930, the capacity of (*a*) prime movers, (*b*) electric generators and (*c*) electric motors at the factories to which the foregoing particulars relate.

TABLE IV.

(a) Prime movers.	1930.
Reciprocating steam engines:—	H.p.
Ordinarily in use	5,442
In reserve or idle	2,190
Steam turbines:—	
Ordinarily in use	5,667
In reserve or idle	1,150
Other prime movers:—	
Ordinarily in use	9,831
In reserve or idle	2,995
Total { Ordinarily in use	20,940
Total { In reserve or idle	6,335

(b) Electric generators driven by	1930.
Reciprocating steam engines:—	Kw.
Ordinarily in use	2,076
In reserve or idle	986
Steam turbines:—	
Ordinarily in use	4,250
In reserve or idle	800
Other prime movers:—	
Ordinarily in use	3,328
In reserve or idle	1,460
Total { Ordinarily in use	9,654
Total { In reserve or idle	3,246

(c) Electric motors driven by	1930.
Electricity generated in own works:—	H.p.
Ordinarily in use	11,596
In reserve or idle	1,376
Purchased electricity:—	
Ordinarily in use	117,040
In reserve or idle	13,166
Total { Ordinarily in use	128,636
Total { In reserve or idle	14,542

Electricity Used.

The total quantity of electricity used in 1930 for all purposes at the works to which this report relates was returned as follows:—

	Million B.T.U.
Electricity generated at firms' works	35.3
Purchased electricity	65.1
TOTAL	100.4

Summary.

The principal aggregate figures shown in the foregoing paragraphs for 1930 are summarised in Table V.

(*Concluded in end column.*)

British Chemical Standards.

The British Chemical Standards Movement held a meeting of co-operators at York on Saturday, January 23, at which the Report on the fifth three-years' working, viz., up to September 15 of last year, was presented. This body, though British in origin, is now international, and produces standard analysed samples used all over the world by means of which the reliability both of the analytical methods used for determing the composition of a large number of materials and of the correct working of them can be verified; in fact, serving for these purposes as gauges or templates for checking sections.

Apart from the commercial advantages of the accurate control of the composition of very large tonnages of materials—both ferrous and non-ferrous—a co-ordinating effect being exercised over many millions of tons, disputes and delays being largely saved, and benefits gained in many ways, another valuable result of this work is the constant investigation by the co-operators of the methods themselves, whereby any weaknesses are detected and eliminated.

Outlines of the methods used by each chemist are published on the certificates issued with each sample, so that a user of a standard can compare his own working of the methods with that of any of the other chemists on the identical sample. The Report—of which a separate review will appear later—showed that, notwithstanding the world-wide difficult business conditions, very considerable progress had been made, not only with the number and types of standards produced, but also of users.

The meeting was well attended by co-operating chemists in the movement from many parts of the country, whilst many regrets of inability to attend, both from this country and abroad, were received.

Dr. J. T. Dunn, who had supported the movement from its early days, was in the chair. Besides co-operators, there were present Mr. P. Good, Deputy Director of the British Standards Institution (formerly B.E.S.A.), Mr. J. Davidson Pratt, General Manager of the Association of British Chemical Manufacturers, and Mr. Vincent C. Faulkner, Editor of THE FOUNDRY TRADE JOURNAL, representing cast ferrous materials generally.

The Report was adopted unanimously, and also a resolution approving the manner in which affairs had been conducted.

Besides this, communications to the same effect were received from twenty-six co-operators who were unable to attend.

The Influence of Shape in Tensile Test-Bars.

(*Concluded from page 69.*)

of comparatively small amount without fracture of the bar occurring. It is, moreover, unlikely that the transfer of stress from the soft centre to the surrounding stronger material will be in actual fact sudden. Early experimenters reporting tests on cast iron have described what is termed "the period of further extension without any increment of load which is almost always observed in the tensile stress-strain curve," referring to observations made at the moment before fracture. If the tensile stress-strain curve of the soft material of a thick casting does curve over and become almost parallel with the strain axis near the fracture stress, the load will be transferred gradually from the centre towards the skin of the bar. The small amount of plasticity which cast iron exhibits in conjunction with elacticity (in the broad meaning of the term) will assist in preventing sudden shock when the centre fibres fail.

These are matters which can only be satisfactorily decided by exhaustive testing. It is in the hope of obtaining further comprehensive test results that these preliminary surmises have been recorded.

Applications of Electric-Arc Welding.

At a meeting of the Cleveland Institution of Engineers, held on January 4, a Paper on "Recent Developments in the Application of Electric-Arc Welding" was read by MR. E. P. S. GARDNER, in the course of which he drew attention to the application of electric welding to the fabrication and erection of structural steelwork, stating that the Metropolitan Gas Company, Melbourne, had fabricated and erected over 20,000 tons of welded structures of all classes and estimated that the overall saving in material varied from 20 to 30 per cent. An important factor peculiar to welded construction was that under certain circumstances it was possible to transport the material straight from mill stock to the site of erection and so eliminate expensive preparation and trial assembly in the shops.

Continuing, the author referred to the application of electric welding to the strengthening of steel structures, which, he said, had offered a valuable solution to railway and municipal engineers faced with the problem of coping with increased traffic loads and depreciation due to corrosion. The number of bridges strengthened by electric welding on Australian and North American railways run into three figures, and quite a considerable amount of important work had been carried out in this country.

The main advantages claimed for this particular application were, briefly, that: (1) In the majority of cases the cost was much lower than when alternative methods of reinforcement were employed. Very often there was no alternative but complete renewal. (2) Delays to traffic passing over the bridge were avoided or greatly reduced. (3) In most cases underpinning or staging was unnecessary, and on principle the existing structure was not weakened or disturbed by the replacement of members and rivets in the initial stages as was often the case with alternative methods.

The strengthening of structures by welding was divided into three broad classes: (1) The reinforcement of riveting or riveted joints in which the welding and riveting acted conjointly in carrying the stresses, as in strengthening lattice-girder connections or plate-girder flange-angle riveting. (2) The reinforcement of existing members by welding on additional plates or sections. (3) The strengthening of girders by increasing their depth or by adding new members, such as extra ties, struts or cross-girders, etc.

Concluding, the author referred to the application of electric welding to (1) oil-storage tanks, the largest of which included three of 3,000,000 galls. capacity erected in Kent. (2) Hydro-electric pipe-lines, the most notable examples in this country being recently installed for the North British Aluminium Company, in connection with the Lochaber hydro-electric power scheme. They consisted of twin pipes 3,200 ft. long and about 5 ft. 6 in. dia., with a rise of 600 ft. (3) Reinforced concrete and (4) permanent-way maintenance.

(*Concluded from first column.*)

TABLE V.

Particulars.	Unit.	1930.
Value of goods made and work done (gross output)	£'000	27,524
Cost of materials used	,,	11,426
Paid for work given out to other firms	,,	160
Net output	,,	15,938
Average number of persons employed	No.	84,819
Net output per person employed ..	£	188
Mechanical power available:—		
Prime movers	H.p.	27,275
Electric motors driven by purchased electricity	,,	130,206

XUM

The Economic Crisis from the French Angle.

By C. Dufour (President of the French Foundry Owners' Federation).

Before the war a few Western Europe industrial countries and the United States furnished the entire world with their products. In these countries each manufacturer developed his methods of production in order to increase his turnover, lower his cost price, and thus obtain the highest profit. The great war came, carrying in its wake enormous needs for material. Every establishment strove to meet these needs. It became necessary to enlarge existing works or to construct new ones. Even in neutral countries the demand for essential armaments for the combatants created similar conditions.

Peacetime requirements being no longer satisfied, other countries began to equip themselves for supplying the everyday needs of normal life. Thus, when the war was over, and the period of essential reprovisioning the world was carried through, the industrial nations had a productive capacity considerably greater than previously, and they found themselves in competition for the world's markets with a new set of competitors. Thus, for example, Japan developed its industry, whilst India not only produced but even exported pig-iron, a commodity which she used to buy. Again, the United States, which had the task of equipping their immense continent, had reached saturation point earlier than she thought, which caused her to protect her domestic market by increasing tariffs and to make a serious attempt at exportation.

Germany, who exported to an enormous extent in 1914, had developed other industries during and after the war beyond all reason, primarily for armaments, but also with an eye to exporting to an increasing market after the war. It is thus reasonable to assume that the world's capacity for production after the war was considerably greater than in 1914.

Reduction in Consumption.

In face of this ceaselessly increasing production, consumption was continually declining. For well-known reasons, China, Japan, India, Russia, Central Europe, Egypt and South America either could not or would not reprovision themselves by buying from the previous suppliers; this corresponds to a loss of at least 1,000,000,000 potential customers. Thus the law of supply and demand was violated, equilibrium between production and consumption was destroyed, and it must be realised that businessmen were scarcely aware of these conditions until recently.

The French Crisis.

In France the situation was different. In 1926-7 their balance of trade was favourable; she would probably have still retained it if their commercial treaties had not been upset, to this extent, that since their launching the deficit of their exchanges has reached a total of 30,000,000,000 francs; that is to say, she has imported more than she has exported, and France is thus impoverished to the tune of 30 milliards. It is fallacious to assert that at the side of this visible balance one must credit the invisible exports which compensate to a certain extent this deficit. Prominent amongst these is the money spent by foreigners visiting France. This particular factor was operative for two or three years, but when one now observes the marasmus of the great hotels, one is forced to regard it as of secondary importance. One could also point to the quantities of gold accumulated in the banks, but this argument is untenable since there is a countervailing responsibility for corresponding commitments. Moreover, there is a source of invisible export—money—which is often forgotten. There are the considerable amounts which foreign workmen send home every month to their families and the savings which they take with them when they finally return to their homes. Her unfavourable commercial treaties are perhaps the result of her desire for a universal union. These treaties have turned out to be economic sacrifices for political considerations. It is, above all, necessary to recognise that it was difficult to prophesy the repercussion of these treaties on her trade exchanges. But to-day the effects of these treaties reveal themselves by an examination of her trade balance. It should be clear that it would be difficult not to denounce these treaties, yet remembering the Latin proverb—To err is human—still it would be diabolical to continue in the error. That is why one cannot conceive the idea of a European customs union, which would have still more evil consequences.

France's neighbours have ceaselessly taken steps to raise tariff barriers. In spite of these commercial treaties which she has signed with them, she sees door after door closed upon her products, whilst they invade her country with even larger and more numerous imports, against which her tariffs, becoming more and more inadequate, cannot operate.

Results of the Deficit.

If instead of having imported, under commercial treaties, an excess of 30 milliards over exports, France's tariff policy had been organised to maintain an equilibrium in the balance of trade, in such a manner as to assure parity of exchange with each nation (and none can protest that such a principle is not equitable), she would have shown a favourable balance of 30 milliards. As the value of a product is largely a function of wages and process costs, which are incorporated therein in every stage of manufacture from the raw material to the finished article, then a virtually similar amount would have been paid out to the workmen and staff. Those reduced to partial or total unemployment cannot spend anything beyond the strict necessities of life. These 30 milliards would have increased their buying capacity by a like amount. A large part of these extra wages would have been spent in buying other products, and one could allow that, say, 20 milliards would have been used for these purchases. Home production would have been increased by this figure; that is to say, the total which France would have produced and consumed would be in the region of 50 milliards more than she has manufactured since the commercial treaties of 1927. Was it necessary that France should have suffered from the existing crisis? Nothing is less certain, because France, through the harmony which exists between her agriculture and her industry, is not obliged to export more than she imports. Moreover, if one allows that her Colonies can be better exploited than they are, then they can bring a serious addition to the enrichment of France. The more the thought given to this notion the more it impresses itself on one.

Balancing Trade.

If one cannot go back on the past and recuperate the lost 30 milliards, one can at least limit this impoverishment in the future. The legislature has only to proclaim that France is going to balance its commercial budget and to re-establish its trade exchanges with each country, a legitimate action incapable of raising any great protests. A single Act of Parliament reading as follows would suffice:—"France must balance its trade exchanges with each nation, she must not pay to any country more money than she receives. To attain this equilibrium, every month an account will be taken of the total sales made to France during the last twelve months by any given country, as well as the account for the same period of purchases made by France from the same country, according to the monthly statistics prepared by the Customs Authority. If the trade balance is a deficit, all articles in the tariff list for that country will be straightaway increased by 10 per cent.; if the trade balance ascertained for the month following after similar examination still remains a deficit a second increase of 10 per cent.; that is, 20 per cent. will be added to all listed dutiable articles coming from that country, and still further similar 10 per cent. increases will be made until a trade equilibrium has been attained. If, on the other hand, the balance is in France's favour, the coefficient for the following month is to be reduced by 10 per cent., and so on, until equilibrium is restored."

By means of this simple law the tariff list would automatically rise and fall for each nation, without fear of any friction arising. The most-favoured nation clauses would still be respected, but for all nations the basic principle would remain that of parity of exchange. It is evident that parity of exchange could not be effective until the elapse of several months, and that during this interval France would risk being submerged by a still greater invasion of foreign produce. The application of this law does not suffice for the protection of France's financial resources, which are already straightened by the incidence of the 30 milliards referred to. Customs tariff relief measures and their contingencies should have immediate attention. France's commercial treaties have been proved to be, where depreciation of currency has occurred, a complete relief from customs tariffs against such countries. For the contingency cited, a second measure would prove useful. Obviously, in cases of national urgency, special measures can be taken. Everything that has been done up to now has been ineffective, as is proved by the trade balance, which becomes more and more deficient. There is no need to fear retaliatory action, as such measures have already been discounted by other nations, which never hesitate to raise their tariff wall constantly and to close their doors whilst France's remain open. To be convinced of this it is only necessary to compare foreign protective tariffs of 1927-8 with those of to-day, whilst France's have scarcely varied. It is to be expected that her exports will be improved by the steps outlined, as the nations which export in excess into France and which require her goods will not limit their purchases of French goods, but will increase their orders, so that they can export their products to France in like quantities. It is obvious that this measure will enrich France. It is useless to hope to have cheap living in a country having agriculture protected. The cost of living cannot be low in France when bread costs 2 frs. 30 a kilo whilst in Belgium it is only 1 fr. In a country where wages are high, where the workmen easily find work, living can be dearer than in countries less favoured, where unemployment and poor taxation returns spell ruin. It cannot be denied that France is dependent on certain countries for some of its raw materials. Rarely are the raw materials the exclusive perquisite of any one country.

Influence of the Deficit on the Customs Returns.

It should be noted that industry pays enormously for imports, and that the budget could not balance itself with it. When turnover decreases (assuming a decrease of 50 milliards) the overheads are lowered to a very much less extent, with the result that the cost price increases and profits disappear. If France could have produced 50 milliards of francs more, the turnover tax taken at all stages of manufacture

(*Concluded on page* 78.)

The High-Frequency Furnace and its Use for the Manufacture of Steel Castings.*

By T. R. Middleton.

It is natural that a great departure from recognised melting practice should at first attract much criticism, and the high-frequency furnace was no exception. Five years have now elapsed since such furnaces were made available for the melting of steel on a commercial scale, but controversies still wage on various questions, and doubts are still prevalent regarding the electrical and metallurgical efficiency of this newer type of melting.

FIG. 1.—A CORNER OF THE SPECIAL STEEL FOUNDRY, ENGLISH STEEL CORPORATION.

On the one hand, we are told that a certain furnace has exceeded all expectations; that the melting cost is comparable with that of the arc furnace, while the quality of steel produced is superior to that previously melted in the crucible. On the other hand, some steelmakers claim that the coreless-induction furnace cannot replace the crucible, since the steel produced in the latter is so much the better quality; they also state that the high-frequency furnace cannot compete with the arc, with regard to either price or quality, and that the necessary electrical equipment is the source of constant trouble, likely to cause prolonged stoppages owing to breakdown.

There is no doubt that until the melters became proficient some inferior steel was produced in the induction furnace, as was the case with all other melting processes when first introduced. Melting costs may have been high, due in part to incorrect charging of raw materials, to poor refractories and to inefficient control of electrical plant, which itself may not have been perfect. What is the present position, and how far have the early expectations of designers and users of these furnaces been justified?

Survey of Development.

The furnace which was introduced by Dr. Northrup in 1916 could scarcely be regarded as a commercial melting unit. Current at a frequency of about 20,000 cycles per second was produced by means of a mercury-gap oscillator. The furnace consisted of a refractory crucible surrounded by a coil which was connected to the source of energy, and the circuit was tuned by means of a bank of condensers. Furnaces of this type have a very low power factor, and condensers are necessary to correct it. The maximum power available from a mercury spark gap is of the order of 50 kw., so that only small melting units could be employed. Such furnaces as are in use to-day would be found chiefly in research laboratories, although one commercial application was the production of carbon-free nickel alloys such as Permalloy and the melting of rare metals.

It was later found that, for larger furnaces, the operating frequency could be considerably reduced, and that the current could be supplied from a synchronous generator. Such generators became available in 1925, and in 1926 the first Ajax-Northrup foundry melting unit, operating at 2,000 cycles per second, was installed in America. During the following year a similar furnace was installed in Sheffield, and a little later a Metropolitan-Vickers furnace, operating at 500 cycles per second, was put down at the Vickers works of the English Steel Corporation. Since that time numerous furnaces have been installed in this country and abroad. In England there has been no demand, probably on account of the bad trade conditions, for furnaces of over 600 lbs. capacity, but in France furnaces ranging up to 25 cwt. in capacity are operating successfully. As regards the design of larger furnaces, there are no technical difficulties in the construction of 10- or 15-ton units, and in this connection it is interesting to note that a 4-ton furnace is now being built in this country for use in Sweden.

Such furnaces as are now in use operate at frequencies of between 500 and 2,000 cycles per second. A typical unit (Fig. 2) shows a 5-cwt. furnace in use at the works of the English Steel Corporation. The furnace is supplied with current by a 160-kw., 500-cycle motor-generator set which is housed in a building immediately behind the furnace stage, where are also the necessary banks of condensers.

After the motor generator has once been started, the equipment is controlled by the melter from the control panel, on which are situated the generator oil-switch control, voltmeter, ammeter, reactive k.v.a. meter and push-buttons for switching condensers in or out as required. Control is simple, but the indicators on the panel must be watched continually and the necessary adjustments made during the course of melting or otherwise the result will be a poor load factor and melting time will be prolonged. The efficiency has been further improved in the more recent equipments by the addition of automatic control gear.

Large Furnaces.

Progress during the past four years has been good, but the development of larger furnaces has not been so rapid as one could have hoped. Great improvements have been made in the design and efficiency of motor-generator sets, which have effected a considerable saving in power. In 1927 the overall generator efficiency was about 60 per cent.; modern 150-kw. generator sets have an overall efficiency of about 80 per cent., while larger generators are still more efficient. The power consumption per ton of steel melted in the older furnaces was from

FIG. 2.—A 5-CWT. HIGH-FREQUENCY INDUCTION FURNACE.

* A Paper read before the Sheffield Section of the Institute of British Foundrymen, Mr. G. C. Castle presiding.

900 to 950 kw.-hrs., while with modern equipments the figure may be as low as 650 kw.-hrs. per ton in the 5-cwt. furnace and still lower in the larger types.

Improvements have also been effected in the design of the furnace unit. In the earlier types the inductor coil was clamped to wooden uprights and the whole housed in a wooden box. Such units were unsatisfactory, since they were easily damaged and warped with the heat, and it is clear that, especially for larger furnaces, a stronger construction is necessary. The obvious framework would be one made of steel, but the stray field is such that if proper precautions are not taken the various members would be heated by eddy current to a considerable temperature. Several types of construction have been adopted, one of which consists of a framework made of non-magnetic steel, the various members of which are arranged, with regard to the strength and direction of the stray field at all points, so that heating by induction is reduced to a minimum. The whole frame is covered with asbestos slate. There are other methods of construction by means of which the stray field may be limited to a definite path, and which would allow the furnace casing to be built of ordinary structural steel plate. One of these consists in surrounding the coil with several packs of laminated transformer iron, while in another the whole of the inside of the casing is lined with ¼-in. thick copper sheet.

There have been other improvements, all of which help to make the modern high-frequency furnace a most efficient melting unit. Condensers for the larger furnaces are now of more robust construction and are water-cooled; the coil design has been modified, as, for example, in the Northrup furnaces, where a graded coil has resulted in a more uniform field which reduces end losses, and heats the charge more uniformly from end to end.

Refractories.

Refractory materials for the lining of high-frequency furnaces have received considerable attention. The pre-burnt clay or plumbago crucibles, which were so very unsatisfactory and had an average life of only five heats, have been replaced by linings built up by other methods. Of these the sintered lining, which may be of acid or basic refractory, is the type most generally used. In preparing the lining, 2 to 3 in. of suitably graded refractory is first rammed on to the furnace bottom, and on this is bedded a hollow mild-steel cylinder having its bottom end closed. The space between cylinder and coil is then carefully rammed with refractory up to the level of the top of the coil, the furnace top and spout being finished off with brick and ganister or by any other suitable method. The procedure then consists in charging raw material into the cylinder and melting down slowly; the refractory is thus sintered and bonded to the form of the cylinder. Such linings are very satisfactory; they are quickly prepared and last for many melts. Rammed linings of ganister have lasted in some cases for over 70 heats, the average being about 55 heats.

Another type of lining which has been recently developed is that built up of unburnt silica or magnesite bricks. The bricks are of special section, having tongue and groove joints, and are generally built into place without cement. There is a small space between brick and coil which is packed with refractory sand, and the top of the furnace may be finished off as in the case of the rammed lining. These bricks are at present being used with considerable success—silica linings lasting for 70 or more heats and magnesite in some cases over 100 melts. The average life is about the same as that of the rammed lining.

Many arguments have been put forward both for and against the high-frequency process of melting, and it is interesting to deal with some of these in detail, in the light of experience gained over the past three years, during which time nearly 7,000 casts of steel have been produced in the 5-cwt. furnace at the works of the English Steel Corporation.

Reliability.

It has been said that generators producing current at the high frequencies required are unreliable, and foundrymen will look upon the necessary electrical gear with doubt, especially if they have not available a competent electrical staff. It would be futile to argue that breakdown will not occur; but generators have been running for some years with no more attention than one would expect to give to any high-speed machine, and in the case of that at the Vickers works, stoppages due to repairs to electrical plant have been under 2 per cent. of the available working time—surely a not unreasonable proportion. If the motor-generator set is housed in a well-ventilated building, kept free from foundry dust, and is used with consideration, there is no reason why any excessive trouble should be experienced. The condensers have given good service and few replacements have been necessary. With regard to the furnace unit, there is little to cause breakdown, and such mishaps as have occurred may, except in some extraordinary circumstances, be put down to carelessness in one form or another. The fact that molten steel is surrounded by a water-cooling tube may be looked upon with apprehension, although the chance of water coming into contact with molten steel is very remote. In one instance, owing to the furnace bottom being not properly made up, some of the sand lagging leaked out, and during the heat the crucible cracked, allowing the molten steel to come into contact with the coil. It was found that no damage had been done either to the furnace or to the coil.

It has been claimed by some sceptics that oxidation losses in the high-frequency furnace are so great, particularly in regard to carbon, that it is impossible to make any steel, to any specification, with certainty. This is far from being the case, although one might be forgiven for predicting high oxidation losses in a furnace with so great a bath turbulence and such ready access to the atmosphere. The height to which the bath wells up in the middle is about 2 in. in the case of a 500-cycle 5-cwt. furnace, and is about 1 in. in the 2,000-cycle unit. It is true that some carbon is lost, and the percentage loss is very nearly the same as in the crucible process; but whereas in the crucible carbon losses are very irregular, it is found that, in the induction furnace, losses may be controlled, and that it is possible to work to narrow ranges of analysis. Table I shows the carbon percentages obtained in 12 consecutive heats of five different steels:—

Table I.—*Carbon Losses in the H.F. Furnace.*

Steel No.	Specification, C per cent.	Calculated. C per cent.	C per cent. obtained.						Average C loss per cent.
1	0.70—0.74	0.84	0.675	0.695	0.72	0.70	0.715	0.755	0.13
			0.715	0.705	0.70	0.72	0.70	0.73	
2	0.65—0.70	0.81	0.67	0.70	0.70	0.695	0.69	0.665	0.13
			0.68	0.69	0.67	0.665	0.68	0.68	
3	0.35—0.45	0.44	0.41	0.38	0.37	0.41	0.40	0.385	0.05
			0.39	0.40	0.37	0.38	0.35	0.39	
4	0.30	0.33	0.32	0.29	0.295	0.295	0.31	0.29	0.03
			0.31	0.285	0.31	0.33	0.29	0.30	
5	0.175—0.225	0.20	0.19	0.195	0.185	0.20	0.19	0.205	0.005
			0.22	0.19	0.19	0.22	0.185	0.20	

Steels Nos. 1 and 2 were of low-alloy content, and Nos. 3, 4 and 5 were steels of high-alloy content. Alloy losses in melting are low, and it is possible to melt high-alloy scrap with little change in analysis. Table II shows the chromium losses during melting of four different steels.

The remelting of manganese-steel scrap does not present any difficulties in a basic-lined furnace, and melting losses are not high. The following results were obtained in remelting three heats of scrap:—

	C per cent.	Mn per cent.
Calculated	1.20	13.60
Analysis obtained ..	1.11	13.18
	1.135	13.38
	1.11	13.18
Average loss ..	0.081	0.35

The high-frequency furnace has thus a decided advantage over other melting processes, it being possible to remelt, for example, stainless-steel scrap, with very little loss of chromium and no carbon pick-up. There is no loss of tungsten or molybdenum, as is experienced in the arc furnace on first heats, and, owing to the circulation of the metal in the furnace, one obtains thorough mixing.

The induction furnace suffers one set-back in its competition with the arc furnace in that, working at frequencies such as are at present usual, large quantities of scrap turnings cannot be melted efficiently. The operating frequency determines the size of scrap which may be melted, the smaller the charge the higher the necessary frequency. In a 500-cycle furnace, for example, the charge should consist of pieces having a diameter of not less than about 1.50 in., if it is to heat up efficiently. This does not mean that no smaller scrap may be used. It is rarely that an ideal charge of scrap is found, and the efficiency with which the heat melts down depends upon the way in which the melter charges the scrap into the furnace. In order to fulfil the best heating conditions, the largest pieces should first be placed in the furnace, spaces being filled in with smaller scrap, and the smallest scrap should be added when the rest has started to melt.

Refining Difficulties.

The attention of metallurgists has for some time been given to the question of refining in a high-frequency furnace. There is no doubt that refining can be carried out, and, owing to the circulatory motion of the bath, slag reactions are extremely rapid. One advantage of induction heating is that the heat is developed in the metal itself, but this is a disadvantage so far as refining is concerned, since the slag is only heated on the underside by the metal bath, and in order to keep a fluid slag it would be necessary to have an auxiliary source of heat. Personal opinion is that the high-frequency furnace can, at present, be best employed in the melting of raw material and scrap of reasonable purity, and that refining, though possible, would not be an economic process.

Table II.—*Chromium Losses in the H.F. Furnace.*

Steel No.	Calculated Cr. per cent.	Per cent. Cr. obtained. Three heats.			Cr. per cent. loss. Average.
11	26.80	25.60	25.75	25.87	1.06
12	17.50	16.84	16.64	17.24	0.59
13	13.30	13.28	13.08	13.02	0.17
14	6.10	6.04	6.00	6.06	0.066

High-frequency melting is exceedingly rapid, and large weekly output is possible with quite a small furnace. The length of time taken to melt a charge will depend on several factors; different steels require different procedures, and the time for "finishing" a heat will vary according to quality and to the melter's judgment. A 5-cwt. furnace is capable of melting a charge in 1 hr. or under, and, including charging and casting times, will average 1½ hrs. per heat.

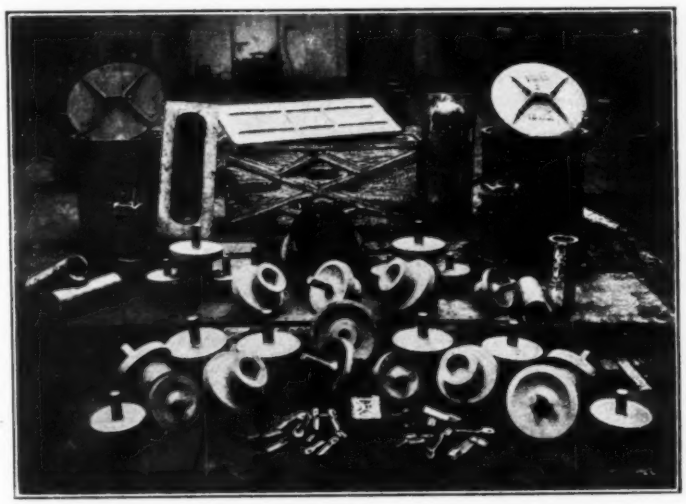

FIG. 3.—STAINLESS AND HEAT-RESISTING CASTINGS.

Non-Ferrous Melting.

So far as non-ferrous alloys are concerned, it is only for the production of those with high-melting points that the coreless induction furnace has been used. Alloys such as brass and bronze are melted far more efficiently in a low-frequency ring-type furnace.

At the time of its introduction, the high-frequency furnace received more attention as a melting unit which was to replace the older crucible process, as a means of producing tool steel, than as a furnace for melting all types of steel required in the foundry. It was not long, however, before the users of these furnaces realised the possibilities of this new method of melting.

Foundry Applications.

It was found that the quality of steel produced was good; melting costs were comparable with arc furnace practice; losses of alloying elements in melting were low, and casting temperatures could be accurately controlled. Here, then, was a furnace which could be tried out, in the first place, to replace the crucible furnace for supplying steel to the small "special steel" foundry, where castings of the heat-resisting and magnet varieties were made. The advantages gained were immediately recognised, and in the English Steel Corporation foundry all castings of this description are made with high-frequency steel. The melting costs were halved, and the quality of casting produced was improved. It was possible to obtain 5 cwts. of steel of one analysis, instead of taking a number of pots from the crucible furnace all of which might vary in analysis. Subsequent heat-treatment of castings was therefore simplified. The quality of steel produced was, in some cases, better than could be made consistently in the crucible, especially magnet steels.

As an improvement on the crucible process for the production of special steels for castings, high-frequency melting has been a success, but to be of great use to the foundry world, it must go much further than replacing the crucible. It will be asked how far the induction furnace can replace, or augment, the open-hearth and arc furnaces in the large steel foundry. So far as cost is concerned, Siemens steel being so much the cheapest that, where the quality is satisfactory, and where a sufficient weight of steel can be dealt with at any one time, induction and arc-furnace steels are definitely precluded. So, at the present time, the high-frequency furnace may be regarded only as a competitor of the arc furnace in the large foundry.

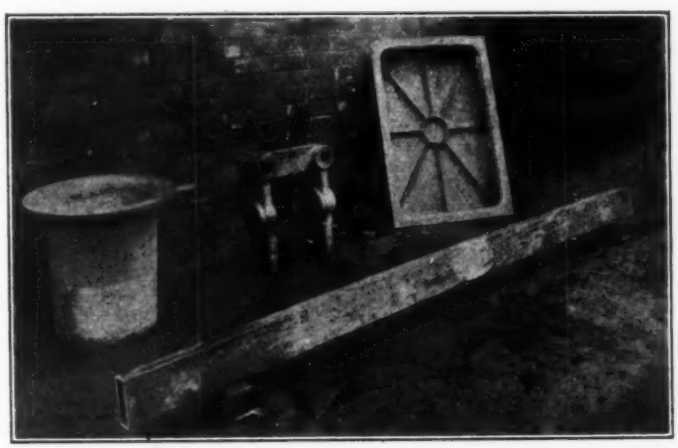

FIG. 4.—CASTINGS IN HEAT-RESISTING STEEL.

Unfortunately, the works in Sheffield have been compelled to carry out experiments and tests on a much smaller scale than has been done elsewhere, but the indications are that production and quality of steel melted in the larger H.F. furnace is equally as reliable as, and in some respects better, than in the 5-cwt. furnace.

Melting Costs.

As regards melting costs, the 5-cwt. furnace turning out 20 tons per week produces steel as cheaply as a 30-cwt. arc furnace, and the 1-ton furnace, with a weekly capacity of about 80 tons, melts rather more cheaply than a 4-ton arc. For intermittent working the induction furnace is definitely the cheaper, since there is no great bulk of refractory to heat up.

Although melting costs may be about the same, the relative costs of steel made by the two processes will depend on the type of steel to be melted, which will determine the class of raw material to be used. Carbon steel may be produced more cheaply in the electrode than in the induction furnace, since the former can absorb far greater quantities of steel turnings. In the medium alloy grades of nickel and nickel-chrome steel, etc., the electrode furnace is still rather the cheaper. In the case of steels of high alloy content, such as the various chromium and nickel-chromium, stainless and heat-resisting alloys, production is made cheaper by using the induction furnace, especially where alloys of low-carbon content are being made.

The high-frequency furnace at the Vickers works has produced steel of all types for the foundry, including low-carbon, various nickel-chrome steels, and manganese steel, in addition to the various special qualities already mentioned. The quality of castings produced has been entirely satisfactory. Tests taken on these castings have been good, and there is no reason to doubt that the furnace is capable of successfully producing any class of steel which may be required in the foundry.

In the small steel foundry the induction furnace is invaluable. Even a small furnace is useful in the large foundry for castings which are a little out of the ordinary analysis and will not absorb a whole heat of electrode steel; also for the production of steel for those special and experimental castings which could not otherwise be made conveniently. In spite of the success with which this furnace has met, it is not thought that the time has yet come when it would be advisable or economical to equip a large foundry solely with this type of melting unit, the arc and open-hearth furnaces having in some cases such a decided advantage as regards cost of steel in the ladle. It is, however, a most valuable accessory, and when the merits of coreless induction melting are fully appreciated by foundrymen no large foundry will be considered complete without its one or more high-frequency furnaces.

THE GRAND COUNCIL of the Federation of British Industries, at its quarterly meeting, reviewed the national position and the policy of industry in relation to it. It was agreed that no change had occurred in the situation which altered the views of industry as to the steps which are required to restore prosperity, and the Council unanimously endorsed a statement setting forth the principal lines which the Government should follow, in order to assist British industry. The Federation's main proposals are: (1) A new spirit of economy in internal government, covering administration, taxation and expenditure, with the object of restoring the competitive efficiency of the country (2) a new fiscal system, and (3) a financial, monetary and investment policy mainly directed towards the restoration of industry and the development of markets for British goods.

This Week's News in Brief.

Trade Talk.

MR. H. K. SCOTT, M.Inst.M.M., has removed from 83, Queen Victoria Street, E.C.4, to 56, Southwark Street, London, S.E.1.

DURING 1931 THE L.M.S. Railway Company built 132 new locomotives. Forty-seven were built at Derby, 70 at Crewe, and 15 at Horwich.

THE IRON, STEEL & IRONMONGERY BENEVOLENT ASSOCIATION reports a considerable increase of membership during the past year. Grants made during the twelve months reached the record amount of £675.

THE NEW STEAMER "Isle of Sark," intended for the Southern Railway Company's Channel Islands service and built by Denny & Bros., Limited, Dumbarton, has undergone successful trials on the Clyde.

MESSRS. WILLIAM DENNY & BROS., LIMITED, Leven Shipyard, Dumbarton, have secured an order from the Southern Railway Company, in conjunction with the French State Railways, to build a new vessel for the Newhaven-Dieppe service.

THE FRENCH FOUNDRY OWNERS' FEDERATION (Syndicat Général des Fondeurs de France) has changed its address from 8, Rue de la Victoire to 23, Rue Chaucat (corner of Rue Lafayette), Paris 9. The telephone number is Taitbout 56-90.

MESSRS. ASHMORE, BENSON, PEASE & COMPANY, LIMITED, Parkfield Works, Stockton-on-Tees, have secured an order for the re-designing and building of a blast furnace for the British (Guest Keen & Baldwins) Iron & Steel Company, Limited, at their Cardiff works.

MR. JULIAN PIGGOTT, manager of the British Steel Export Association, was the guest of the Royal Empire Society at a luncheon at the Cannon Street Hotel, London, on Tuesday. The subject of his address was "Canada: The Steel Trade's Endeavours to Achieve Imperial Co-operation."

SIR ROBERT HORNE will be the principal guest at the annual dinner of the London Iron and Steel Exchange, which is to take place at the Dorchester Hotel, Park Lane, on February 24. The chair will be taken by Mr. Cyril Watts, chairman of the Management Committee of the Exchange, and the guests will include a number of well-known members of the iron and steel trade. As it is anticipated that there will be an exceptional demand for tickets, members of the Exchange should send in their applications at an early date, as they will be dealt with in the order in which they are received.

PRINCE GEORGE paid a visit to the Carron Works on Monday, January 18, as part of his tour of Scottish industries. He was met on his arrival by Mr. F. L. Burder, chairman of the Carron Company, and the directors and manager. On entering the works, two tablets built into the stonework were pointed out to the Prince. One, with the date 1760, was part of the first blast furnace, while the other formed part of the cylinder made at the works in 1766 for James Watt's first steam engine. At the blast furnaces a "cast" was in progress, and, after viewing this operation, the party ascended to the top of the furnaces. A visit was afterwards paid to the moulding shops and other parts of the works. During his tour Prince George also visited the Glasgow works of Messrs. Sir William Arrol & Company, Limited.

THE IRON AND STEEL TRADES CONFEDERATION'S scheme for the reorganisation of the iron and steel industry was discussed at a workers' meeting in Middlesbrough Town Hall recently. Mr. R. Dennison, J.P. (assistant secretary of the Iron and Steel Trades Confederation), moved a resolution which read:—"That this meeting regards the serious position of the iron and steel industry as a matter of fundamental national importance. The extent to which it enters into the economic life of the country, the communities which have developed around its activities, the large number of workpeople dependent upon its progress and stability, and its position in relation to our export trade, make it imperative in the national interests that immediate steps be taken to secure the necessary conscious planning, organised control, and the financial means for its rehabilitation and progressive development." Referring to the resolution, Mr. Dennison said the iron and steel industry was in a deplorable condition. Whatever the merits, if any, that there might be in tariffs for iron and steel, something far more was needed. Industry was ripe for a national planning and controlling. Useless and wasteful cut-throat competition was too prevalent, and little or no attempt was being made on international lines to bring about co-ordination and the raising of the standards of the workers engaged in this important industry.

AT THE ANNUAL MEETING, last week, of the Swansea Metal Exchange, Mr. Frank Rees, J.P., was unanimously re-elected President. Reviewing the industrial position, Mr. Rees said they had never experienced a more depressing period than the year 1931. The steel, sheet and tinplate industries were inter-dependent, but attempts at co-operation had succeeded only for a time, and that partially. What amazed those outside the industry more than anything else was that organisations which were essential in times of depression and falling demand, were only tried when trade was comparatively good, and were immediately discarded at the time trade was on the downward grade and such organisations were most needed. Attempts were once more being made to organise afresh a pool or quota system in the tinplate trade. Without in any way pre-judging the proposals as such, he expressed the hope that out of the chaos in which the industry found itself, it would be possible to arrive at some order as the result of the adoption of a co-operative scheme. He, however, uttered a word of warning. Co-operative schemes which did not include 100 per cent. of the industry could never be wholly satisfactory, because it was the few that remained outside who would contribute most towards instability and depression of price levels. On the question of the safeguarding of the iron and steel industry, Mr. Rees said they were looking forward with much hope to the declaration of the Government's policy when Parliament met at the beginning of next month. No Parliamentary legislation, on its own, however, would solve all their difficulties. All sections of the industry could and should co-operate.

Personal.

MR. JAMES TINCH, works manager of Cockburns, Limited, Cardonald, Glasgow, has just completed 50 years' continuous service with that firm. He has served three generations in the management, commencing with Mr. David Cockburn, the founder, later with his son, Mr. Robert Cockburn, and latterly with the new company, Cockburns, Limited. The company directors have made suitable acknowledgement of the event, and, together with the staff and foremen, have presented Mr. Tinch with a wireless set in token of appreciation of his service.

MR. ERNEST B. HALL, chairman of Messrs. Hall & Pickles, Limited, Manchester and Sheffield, and Mrs. Hall, recently celebrated their silver wedding anniversary. The event was made the occasion of an unique presentation by 34 members of the staff, including directors and employees, who were with the firm at the time of the wedding, and are still either actively employed or superannuated. One subscriber joined the firm in 1879. Another event of interest in connection with this firm was the dedication on January 9 of a new window and additions to the Church of St. Peter, at Broughton, Staffordshire, as a memorial to the late Mr. John Hall, who, at the time of his death, was chairman of Messrs. Hall & Pickles, Limited, the British Reinforced Concrete Engineering Company, Limited, and the Chatwood Safe Company, Limited, the memorial being subscribed for entirely by the directors and employees of the three firms.

Obituary.

MR. HENRY LAWRENCE BEARE, of Messrs. Beare & Sons, Limited, engineers and founders, Newton Abbot, died on January 14, aged 49.

WE REGRET TO ANNOUNCE the death last Monday of Mr. Cree, father of Mr. F. J. Cree, foundry manager to Messrs. Aveling & Porter, of Rochester. The deceased gentleman was one of the old school of foundrymen, and for many years was in charge of the foundries of Messrs. W. N. Nicholson & Sons, engineers, Newark-on-Trent, retiring from active business in 1906.

Institution of Chemical Engineers.

The tenth annual meeting of the Institution of Chemical Engineers is to be held at the Hotel Victoria, Northumberland Avenue, London, W.C.2, on February 19, when the PRESIDENT, Mr. W. A. S. Calder, will give his address, the subject being "Control of Industry."

After luncheon, DR. EZER GRIFFITHS, F.R.S., of the National Physical Laboratory, will present a Paper on "Thermal Insulation," in which he will deal with types of apparatus for thermal conductivity measurements, investigations into heat loss from a pipe surface in air, characteristics of some heat-insulation materials and methods of estimating heat flow in complex structures.

In the evening, in the Grand Hall of the Hotel, the annual dinner will be held under the Presidency of Mr. Calder. The principal speaker will be Sir Harry McGowan, K.B.E., chairman of Imperial Chemical Industries, Limited, whilst the Rt. Hon. Lord Leverhulme (President-Elect) and Sir John Cadman, K.C.M.G., are also expected to speak.

New Companies.

Remy-Steelworks, Limited, 45B, Linden Gardens, London, W.—Capital £1,000. Directors: H. Wolff and F. Nidda.

British Diesel Power, Limited, 3, London Wall Buildings, London, E.C.—Capital £100 in 5s. shares. Mechanical engineers, ironfounders, etc.

F. V. Rotors, Limited, Saltford, Somerset.—Capital £25,000. Engineers and founders. Directors: C. Hughes, J. H. Scott, G. L. Lloyd and S. A. Horstmann.

Crawford & Company (Tottenham), Limited, 46, Derby Road, West Green, London, N.—Capital £1,000. Ironfounders. Directors: H. C., L. B. and C. J. Linzell and E. A. Moranne.

Reports and Dividends.

Fairfield Shipbuilding & Engineering Company, Limited.—Payment of the dividend on the preference shares is postponed.

Steel Developments, Limited.—Net profit, £4,538; brought in £3,871; dividend of 6 per cent., tax free, for the year £4,494; carried forward, £3,915.

Herbert Morris, Limited.—Full half-year's dividend for the half-year to January 31, 1932, on the 6 per cent. and the 5 per cent. cumulative preference shares.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

37,172. FRITZSCHE, DR. P. C. Method of and apparatus for casting metals and ceramic masses and other suitable materials by the centrifugal process. 358,363.

37,300. KRUPP AKT.-GES., F. Casting moulds for use in the manufacture of cast-iron socket pipes by centrifugal casting. 358,365.

20,880. GODEFROID, A. Production of gas-free and oxide-free cast bars and other castings. 358,563.

23,249. HEIMBACH, J., and RHEINISCHE METALLWAAREN-UND MASCHINENFABRIK. Hot drawing of seamless tubes. 358,638.

23,514. SPOONER, W. W. Casting or moulding metals. 358,641.

28,097. ERICHSEN, A. M. Moulds for casting metals and metal alloys. 358,697.

30,689. KITCHING, W. T., and FOWLER (DON FOUNDRY), LIMITED, J. Machined flat-jointed cast-iron split-ingot mould. 358,730.

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WE PRODUCE

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In suitable qualities for the manufacture of:
HIGH CLASS ENGINEERING CASTINGS, MOTOR CYLINDERS, LIGHT CASTINGS, RAINWATER GOODS, BATHS, RANGES, GRATES, STOVES, HOLLOW WARE and all FOUNDRY PURPOSES.

We also make Forge Iron for Wrought Iron Makers and Basic Iron for Steel Works use.

RANGE OF ANALYSIS

SILICON : ·50% to 5%
SULPHUR : trace to ·10%
MANGANESE : ·30% to 4%
PHOSPHORUS : ·50% and upwards

PROPRIETORS OF LOWICK GANISTER
AS USED BY THE LEADING IRON FOUNDERS.

STEWARTS AND LLOYDS LTD

SALES OFFICE: BROAD STREET CHAMBERS, BIRMINGHAM.
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Raw Material Markets.

There has been little movement in the iron and steel markets during the past week, the majority of consumers being inclined to await the outcome of the tariff proposals. More inquiries are being received from overseas, but few orders have so far resulted. In the home pig-iron markets, business has been slow, as most consumers are already covered for the first quarter. Delivery instructions have been quite fair, however, and some small parcels have been sold for immediate delivery. The order books of the heavy foundries leave much to be desired, and the fact that they have large stocks of material does not tend to improve the tons of the pig-iron markets.

Pig-Iron.

MIDDLESBROUGH.—There have been no new developments in the home market. Deliveries to consumers against current contracts remain on a satisfactory level, but there is a scarcity of new orders. The market appears to be holding back pending the development of the proposals for a tariff on iron and steel. In the export section, business is disappointing. Little Continental iron is coming into Scotland, but any opportunities provided thereby have been taken by the Midland manufacturers, who are able to undercut the Cleveland makers in the Scottish market. There has been no alteration in prices, which remain as follow:—No. 3 Cleveland G.M.B., 58s. 6d.; No. 1 foundry, 61s.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

There has been a slight improvement in the East Coast hematite market. Several large orders have been secured from Midland steelmakers. Messrs. Dorman, Long & Company, Limited, have restarted a hematite furnace, making a total of five furnaces producing East Coast hematite, but the output of the extra furnace will mostly be required for the local steelworks. Parcels of East Coast mixed numbers can be bought for 64s. 6d. to 64s. 9d. for immediate delivery, 65s. per ton being the forward quotation. There has also been an improvement in the West Coast hematite market, local consumption being larger than for some time. The United Steel Companies have now lit their new furnace at Workington, which is able to produce 3,000 tons of hematite per week.

LANCASHIRE.—Sellers in this market have somewhat lost confidence during the past week, as business is so poor. The few orders received come mainly from the light-castings makers, the general foundries being badly in need of work. It is felt that consumers are putting a larger proportion of their iron into stock. Prices remain unchanged, with Midland foundry makes offered for delivery to users in the Manchester price zone at 67s. per ton, North-East Coast at 67s., Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish pig-iron at about 87s. and West Coast hematite at 81s.

MIDLANDS.—Trade in this area is not unsatisfactory, deliveries being on a good scale. The majority of consumers are covered for the first quarter, but several small orders have been given out. Producers also find that their raw materials are mounting in cost, and hence are not eager to commit themselves ahead. For delivery to Birmingham and Black Country stations, makers quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Business in pig-iron is practically at a standstill, consumers already having large stocks. Only a few small orders have been reported. No. 3 Scottish foundry remains at 69s. 6d. f.o.r. furnaces, with No. 3 Middlesbrough at 60s. 6d. Other English makes are about 2s. less. Practically no Continental iron is on the market.

Coke.

In the Birmingham district, the position of furnace coke has improved, and sales have shown an increase. On the other hand, foundry coke is moving very slowly. Prices (f.o.t. Birmingham) are:—Best Welsh foundry, 32s. to 39s. 6d.; second quality, 29s. to 32s. 6d.; best Durham, 34s. to 37s. 6d.; furnace, 21s. to 23s. 6d.; gas, 22s. to 23.

Steel.

Very little business is being transacted in the market for semi-finished steel. The home works report no improvement in demand. Few sales of Continental material are being transacted, as foreign makers prefer to reduce output rather than cut prices any further; especially as negotiations are in progress for the formation of a selling syndicate for Continental semis. There is also no sign of development in the finished-steel trade, and producers can only keep their plant operating on a day-to-day basis, as the orders received are chiefly for small tonnages. There is no improvement in the heavy consuming industries. More Continental bars are being sold, and the home rollers are experiencing severe competition.

Scrap.

In the Cleveland scrap-iron and steel market several large consumers of heavy steel scrap are holding off in an attempt to lower prices, but the merchants remain firm. Some small parcels have been sold at 40s. per ton, delivered, but the general quotation remains at 42s. 6d. In the Midlands, also, consumers are seeking lower prices, but few merchants have so far made any concession. Good heavy machinery metal, broken into cupola sizes, remains at 52s. 6d. per ton, delivered. There is no improvement in the demand for scrap iron and steel in either South Wales or Scotlnad.

Metals.

Copper.—The curtailment of output by the mines to 26¼ per cent. of capacity is being put into effect, but this fact has not greatly influenced the market. The Exporters' quotation remains at 7.625 cents c.i.f. Europe, but the average sales last week amounted to less than 200 tons a day, consumers being supplied at a lower figure from outside sources and by second-hand holders of electro. Buying has been on a small scale. It does not seem likely, however, that there will be any reduction in the Exporters' c.i.f. quotation, as the producers have agreed not to release their present stocks until the price rises to a much higher (but, at present, undivulged) level.

Closing quotations :—

Cash.—Thursday, £39 7s. 6d. to £39 10s.; Friday, £38 13s. 9d. to £38 15s.; Monday, £38 15s. to £38 17s. 6d.; Tuesday, £39 to £39 1s. 3d.; Wednesday, £38 15s. to £38 16s. 3d.

Three Months.—Thursday, £39 8s. 9d. to £39 11s. 3d.; Friday, £38 17s. 6d. to £39; Monday, £39 to £39 2s. 6d.; Tuesday, £39 2s. 6d. to £39 3s. 9d.; Wednesday, £38 17s. 6d. to £38 18s. 9d.

Tin.—The market remains steady, although little business has been transacted with consumers. The Welsh tinplate industry continues to experience a mild recovery in business, but no other encouraging signs are noticeable. In America, the market has been subjected to cheap selling by dealers, but the latter's stocks are now nearly all liquidated. Another favourable point is the increase in the United States output of motor-cars during the month of December.

Official closing prices :—

Cash.—Thursday, £141 6s. 3d. to £141 8s. 9d.; Friday, £140 2s. 6d. to £140 5s.; Monday, £138 15s. to £138 17s. 6d.; Tuesday, £140 5s. to £140 7s. 6d.; Wednesday, £139 15s. to £139 17s. 6d.

Three Months.—Thursday, £144 7s. 6d. to £144 10s.; Friday, £143 2s. 6d. to £143 5s.; Monday, £141 15s. to £141 17s. 6d.; Tuesday, £143 5s. to £143 7s. 6d.; Wednesday, £142 12s. 6d. to £142 15s.

Spelter.—Business with consumers has shown no improvement, but holders are not pressing for sales, and the price remains steady. The strong control exercised by the producers considerably strengthens the tone of the market. Otherwise, the increase in stocks shown by the December statistics, and the fact that the depression in the galvanising industry shows no sign of alleviation, are distinctly unfavourable factors.

Daily fluctuations :—

Ordinary.—Thursday, £14 8s. 9d.; Friday, £14 6s. 3d.; Monday, £14 6s. 3d.; Tuesday, £14 8s. 9d.; Wednesday, £14 6s. 3d.

Lead.—Consumers continue to show little interest in the market, and it is difficult to see any sign of recovery. The annual statistics for 1931 are not encouraging. The United States output dropped from 688,787 short tons in 1930 to 478,591 tons last year. Deliveries fell from 637,384 to 429,949 tons, so that stocks were increased by just over 48,000. Stocks fell between May and September in 1931, but increased again in the last quarter.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £14 16s. 3d.; Friday, £14 16s. 3d.; Monday, £14 17s. 6d.; Tuesday, £14 18s. 9d.; Wednesday, £14 16s. 3d.

Catalogue Received.

Molybdenum in Cast Iron.—High-Speed Steel Alloys, Limited, Ditton Road, Widnes, have sent us an advance copy of a brochure covering some results of research work undertaken by the Molybdenum Corporation, of America. The material, it should be noted, was melted in an acid-lined electric-arc furnace. The base irons used were:—(1) T.C. 3.18, C.C. 0.66, Si 2.12, Mn 0.70, S 0.098 and P 0.235 per cent., and (2) T.C. 3.21, C.C. 0.68, Si 2.00, Mn 0.63, S 0.098 and P 0.272 per cent. To the first series there was added 0.13 per cent. of Mo and then, successively, 0.07, 0.14, 0.19 and 0.31 per cent. of Cr, and, finally, 0.22, 0.55 and 1.49 per cent. of nickel. To the second series an addition of 0.37 per cent. of Mo was made, followed by like increments of Cr, as was the case in Series I. The final six experiments in this second series carried increments of nickel, ranging from 0.31 to 3.93 per cent. The highest tensile was reached with 0.37 per cent. Mo and 0.19 per cent. Cr, attaining 22 tons per sq. in., as against 13.8 tons for the base iron.

An exceeding high transverse of 6,075 lbs. per sq. in. was given by an iron containing 0.37 per cent. Mo and only 0.06 per cent. Cr—a figure we should like to see confirmed. We have two minor criticisms to make; the first concerns the research itself, which, in our opinion, would have been better if conducted upon a higher-strength base metal. The second is that for the benefit of British readers the tensile figures should have been converted to tons per sq. in. In conclusion, we counsel our readers to procure a copy of this brochure, as figures showing an increase in tensile of 60 per cent. cannot be lightly dismissed. Moreover, we have yet to learn how these irons react to heat-treatment, a field where we imagine they will probably shine.

The Economic Crisis from the French Angle.

(*Concluded from page* 72.)

and at the final sale would yield an increase of several milliards. It would also be the same for the tax on profits, both manufacturing and commercial, which are either reduced or non-existent since the crisis resulting from this excess of imports. Other taxes would be similarly affected by internal trade expansion.

Again, reduction in business means unemployment, which came about in 1931 and which would certainly not have happened if there had been no excess of imports over exports. This will increase in 1932 if the French balance of trade continues to produce a deficit. There is no time to lose in altering energetically a condition which is dangerous both for French finance and social stability.

[This exceedingly interesting and commonsense suggestion made by Mr. Dufour would certainly be welcomed in British trade circles, as the balance is in France's favour, which under the arrangement called for would mean a lowering of tariffs against Britain. In 1930 the figure was £12,800,000.—Editor.]

Colvilles
PIG IRON
BRANDS "DALZELL" "GLENGARNOCK" "CLYDE" & "MONKLAND"
HIGH GRADE HEMATITE PIG IRON
SPECIAL & ORDINARY FOUNDRY QUALITIES & FORGE
SPECIAL REFINED WITH TOTAL CARBON
GUARANTEED NOT EXCEEDING 3.0% MAX.

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CAST IRON FLANGED PIPES

2 in.—12 in. & CONNECTIONS. to 24 in. dia.

WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.

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Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	38	15	0
Three months	38	17	6
Electrolytic	45	0	0
Tough	41	0	0
Best selected	41	5	0
Sheets	77	0	0
India	53	10	0
Wire bars	49	10	0
Do., February	48	5	0
Do., March	47	0	0
Ingot bars	49	10	0
H.C. wire rods	49	10	0
Off. av. cash, Dec.	38	6	5 5/11
Do., 3 mths., Dec.	38	19	1 17/22
Do., Sttlmnt., Dec.	38	6	3
Do., Electro, Dec.	45	14	1 1/11
Do., B.S., Dec.	40	6	9
Do., wire bars, Dec.	46	19	1 1/11
Solid drawn tubes			11½d.
Brazed tubes			11½d.
Wire			7½d.

BRASS.

Solid drawn tubes	10d.
Brazed tubes	12d.
Rods, drawn	9d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	8d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6½d.
Do. 4 × 3 Sheets	6½d.

TIN.

	£	s.	d.
Standard cash	139	15	0
Three months	142	12	6
English	141	5	0
Bars	143	15	0
Straits	143	0	0
Australian	141	10	0
Eastern	146	15	0
Banca	158	5	0
Off. av. cash, Dec.	138	19	7 5/22
Do., 3 mths., Dec.	141	19	3 7/11
Do., Sttlmt., Dec.	138	19	6 6/11

SPELTER.

	£	s.	d.
Ordinary	14	6	3
Remelted	13	5	0
Hard	11	5	0
Electro 99.9	16	12	6
English	15	2	6
India	13	5	0
Zinc dust	23	0	0
Zinc ashes	3	15	0
Off. aver., Dec.	14	11	9 21/44
Aver. spot, Dec.	14	7	2 13/22

LEAD.

	£	s.	d.
Soft foreign ppt.	14	16	3
English	16	5	0
Off. average, Dec.	15	5	5 3/11
Average spot, Dec.	15	3	9

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whf.	23	10	0
Rods	32	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese	27	5	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	17	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£5 17 6
45/50%	£9 17 6
75%	£15 17 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, 4/2, plus 55%, per lb. of Mo.	
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£21 0 0
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£35 15 0
4/6% car.	£25 2 6
6/8% car.	£23 0 0
8/10% car.	£22 15 0
Ferro-chrome—	
Max. 2% car.	£36 5 0
Max. 1% car.	£43 2 6
Max. 0.70% car.	£52 0 0
70% carbon-free	11d. lb.
Nickel—80/99.5%	£240 to £245
Ferro-cobalt	8/6 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¼ in.	3d. lb.
Do., under 1 in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	5	0	to 2	6	6
Bundled steel and shrngs.	1	17	0	to 1	18	0
Mixed iron and steel	2	0	0	to 2	2	6
Heavy cast iron	2	6	6	to 2	7	6
Good machinery for foundries				2	12	0
Cleveland—						
Heavy steel				2	0	0
Steel turnings				1	12	6
Cast-iron borings				1	6	0
Heavy forge				2	17	6
W.I. piling scrap				2	10	0
Cast-iron scrap	2	5	0	to 2	7	6
Midlands—						
Light cast-iron scrap				2	0	0
Heavy wrought iron				2	12	6
Steel turnings, f.o.r.				1	2	6
Scotland—						
Heavy steel				2	2	6
Ordinary cast iron				2	12	0
Engineers' turnings				1	11	6
Cast-iron borings				1	12	0
Wrought-iron piling				2	7	6
Heavy machinery				2	15	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	22	0	0
Lead (less usual draft)	12	10	0
Tea lead	9	10	0
Zinc	6	10	0
New aluminium cuttings	62	0	0
Braziery copper	27	0	0
Gunmetal	26	0	0
Hollow pewter	90	0	0
Shaped black pewter	70	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/-
Hematite M/Nos.	64/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
„ d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	61/-
„ No. 3 fdry.*	66/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	57/6
„ fdry. No. 3*	62/6
„ fdry. No. 1*	65/6
Derbyshire forge*	61/-
„ fdry. No. 3*	66/-
„ fdry. No. 1*	69/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
„ No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
„ fdry. No. 3	63/6
Lincs forge	—
„ fdry. No. 3	63/6
E.C. hematite	75/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
„ fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/-
Clyde, No. 3	87/-
Monkland, No. 3	87/-
Summerlee, No. 3	87/-
Eglinton, No. 3	87/-
Gartsherrie, No. 3	87/-
Shotts, No. 3	87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	15	0	to 10	0	0
Nut and bolt iron	8	7	6	to 8	10	0
Hoops	10	10	0	to 12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0	to 12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	5	0
Steel—						
Plates, ship, etc.	8	15	0	to 8	17	6
Boiler plts.	8	15	0	to 9	15	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)				6	15	0 & up.
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0	to 8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	10	0
Black sheets, 24g.	8	0	0	to 9	0	0
Galv. cor. shts.	9	0	0	to 9	5	0
Galv. flat sheets	9	10	0	to 9	15	0
Galv. fencing wire, 8g. plain				12	10	0
Billets, soft	5	7	6	to 5	12	6
Billets, hard				6	12	6
Sheet bars	5	0	0	to 5	5	0
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11¾d.
Sheet to 10 w.g.	12¾d.
Wire	13¾d.
Rods	11¾d.
Tubes	17d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.64
No. 2 foundry, Valley	15.50
No. 2 foundry, Birm.	12.00
Basic	16.89
Bessemer	17.89
Malleable	17.89
Grey forge	17.44
Ferro-mang. 80%	75.00
O.-h. rails, h'y, at mill	43.00
Billets	28.00
Sheet bars	28.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.50
Tank plates	1.50
Beams, etc.	1.50
Skelp, grooved steel	1.50
Skelp, sheared steel	1.50
Steel hoops	1.65
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.80
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 25/-
„ furnace	17/6 to 18/-
Durham and Northumberland—	
„ foundry	14/6 to 15/-
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	14/- to 14/9	
„	28×20 „	28/- to 29/6	
„	20×10 „	—	
„	18¾×14 „	—	
C.W.	20×14 „	12/9 to 13/-	
„	28×20 „	25/3	
„	20×10 „	19/4½	
„	18¾×14 „	13/9	

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	Fittings.
Gas	65%	57½%
Water ..	61½%	52½%
Steam ..	57½%	47½%

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Jan. 21 ..	39	7	6	dec.	7/6
„ 22 ..	38	13	9	„	13/9
„ 25 ..	38	15	0	inc.	1/3
„ 26 ..	39	0	0	„	5/–
„ 27 ..	38	15	0	dec.	5/–

Electrolytic Copper.

		£	s.	d.		
Jan. 21 ..	45	10	0	dec.	20/–
„ 22 ..	45	0	0	„	10/–
„ 25 ..	45	0	0	No change	
„ 26 ..	45	0	0	„	„
„ 27 ..	45	0	0	„	„

Standard Tin (cash).

		£	s.	d.		
Jan. 21 ..	141	6	3	dec.	3/9
„ 22 ..	140	2	6	„	23/9
„ 25 ..	138	15	0	„	27/6
„ 26 ..	140	5	0	inc.	30/–
„ 27 ..	139	15	0	dec.	10/–

Tin (English ingots).

		£	s.	d.		
Jan. 21 ..	142	17	6	dec.	7/6
„ 22 ..	141	15	0	„	22/6
„ 25 ..	140	5	0	„	30/–
„ 26 ..	141	15	0	inc.	30/–
„ 27 ..	141	5	0	dec.	10/–

Zinc Sheets (English).

		£	s.	d.		
Jan. 21 ..	24	10	0	No change	
„ 22 ..	24	10	0	„	„
„ 25 ..	24	10	0	„	„
„ 26 ..	24	10	0	„	„
„ 27 ..	24	10	0	„	„

Spelter (ordinary).

		£	s.	d.		
Jan. 21 ..	14	8	9	dec.	1/3
„ 22 ..	14	6	3	„	2/6
„ 25 ..	14	6	3	No change	
„ 26 ..	14	8	9	inc.	2/6
„ 27 ..	14	6	3	dec.	2/6

Lead (English).

		£	s.	d.		
Jan. 21 ..	16	5	0	dec.	5/–
„ 22 ..	16	5	0	No change	
„ 25 ..	16	5	0	„	„
„ 26 ..	16	5	0	„	„
„ 27 ..	16	5	0	„	„

AVERAGE MONTHLY PRICES OF STEEL SHIP ANGLES (NORTH OF ENGLAND).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	4 15 0	4 17 6	5 0 0	5 0 0	5 0 0	4 17 6	4 17 6	4 17 6	4 17 6	5 0 0	5 7 6	5 7 6	4 19 9½
1897	5 7 6	5 7 6	5 7 6	5 5 0	5 0 0	5 0 0	5 2 6	5 2 6	5 2 6	5 2 6	5 5 0	5 3 6	5 3 6½
1898	5 5 0	5 5 0	5 5 0	5 7 6	5 13 9	5 15 0	5 15 0	5 15 0	5 17 6	6 0 0	6 5 0	6 7 6	5 14 3
1899	6 10 0	6 12 6	6 15 0	6 15 0	6 17 6	6 17 6	7 0 0	7 0 0	7 5 0	7 5 0	7 12 6	7 15 0	7 0 5
1900	7 15 0	8 0 0	8 2 6	8 5 0	8 5 0	8 7 6	8 7 6	8 2 6	8 2 6	8 0 0	7 10 0	7 10 0	8 0 7½
1901	6 15 0	6 12 6	6 5 0	6 0 0	6 0 0	5 10 0	5 15 0	5 17 6	6 0 0	5 17 6	5 17 6	5 15 0	6 0 5
1902	5 12 6	5 10 0	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 7 6	5 11 8
1903	5 6 3	5 6 3	5 7 6	5 12 6	5 12 6	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 0 0	5 8 9
1904	5 0 0	4 17 6	5 2 6	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 0 0	5 0 0	5 0 0	5 5 0	5 2 6
1905	5 5 0	5 7 6	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 12 6	6 2 6	6 12 6	6 12 6	5 14 4½
1906	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	7 2 6	6 13 4
1907	6 17 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	6 12 6	6 12 6	7 0 5
1908	6 2 6	6 2 6	6 2 6	5 17 6	5 17 6	5 17 6	5 17 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 16 3
1909	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 9 7
1910	5 12 3	5 17 6	5 17 6	6 1 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 7 6	6 7 6	6 7 6	6 2 3½
1911	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 9 0	6 7 8½
1912	6 17 3	6 17 6	6 17 6	7 5 0	7 7 6	7 7 6	7 7 6	7 12 6	7 12 6	7 12 6	7 14 6	7 17 6	7 7 4½
1913	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 11 6	7 7 6	6 15 6	6 7 6	6 2 6	7 8 11½
1914	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	5 15 0	5 15 0	6 15 0	7 0 0	7 0 0	7 1 3	7 5 0	6 8 7½
1915	7 17 0	8 5 0	8 17 6	9 5 0	9 5 0	9 15 0	9 15 0	9 15 0	9 15 0	9 15 0	10 15 0	10 15 0	9 8 2½
1916	11 3 1½	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6
1917	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6
1918	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 0½
1919	11 2 6	13 12 6	13 12 6	13 12 6	17 2 6	17 1 3	17 0 0	17 15 0	17 15 0	17 15 0	17 17 6	18 5 0	16 1 9
1920	19 10 0	20 0 0	21 10 0	22 0 0	23 5 0	24 0 0	24 0 0	24 0 0	24 15 0	24 10 0	24 0 0	24 0 0	22 19 2
1921	22 10 0	20 12 6	19 0 0	17 10 0	17 0 0	16 6 0	14 10 0	14 3 4	13 10 0	11 15 0	10 0 0	9 12 6	15 11 7
1922	9 17 6	10 0 0	10 0 0	10 0 0	10 0 0	9 17 6	9 10 0	8 15 7½	8 14 0	8 12 6	8 12 6	8 12 6	9 7 8½
1923	8 18 1½	9 1 3	9 14 0	10 0 0	10 0 0	10 0 0	9 8 9	9 9 6	9 10 0	9 8 9	9 11 6	9 18 9	9 11 9½
1924	10 0 0	9 18 1½	9 17 6	9 17 6	9 17 2	9 11 3	9 15 0	9 15 0	9 9 4½	9 6 6	9 5 0	9 5 0	9 13 1½
1925	9 2 0	9 0 11½	9 0 0	8 15 9	8 10 3½	8 9 0½	8 6 3	8 2 6	7 19 0½	7 12 3	7 5 0	7 2 6	8 5 5½
1926	7 2 6	7 2 6	7 2 6	7 3 4	7 2 6	7 3 9	7 7 6	7 8 5½	7 9 0	7 12 6	7 16 3	8 0 6	7 7 7½
1927	7 18 9	7 17 6	7 17 6	7 14 8½	7 13 9	7 12 6	7 12 6	7 12 6	7 12 6	7 12 6	7 12 6	7 12 6	7 14 1½
1928	7 12 6	7 14 9	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 16 10½
1929	7 17 6	7 17	7 17 6	7 17 6	8 0 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 5 0	8 0 10½
1930	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1931	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6

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All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

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SMALL ADVERTISEMENTS.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

EXPERIENCED Jobbing MOULDER, disengaged, requires situation.—Full particulars on application to A. B. S., c/o 70, Princess Street, Burton-on-Trent.

FOUNDRY MANAGER (non-ferrous), with first-class references, open to re-engagement; exceptional experience bench, floor, machine moulding, etc.; best results at lowest costs.—Box 982, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ROLL CASTER (Metallurgist) desires change; wide experience in roll-making of all kinds, also general foundry experience.—Box 992, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN for machine-moulding section of grey-iron foundry producing light electrical castings. An excellent opportunity for young man with enthusiasm and ambition capable of obtaining high output with low scrap.—Apply, stating age, experience, and salary, Box 984, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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REPRESENTATIVE, energetic, experienced, required to specialise in sale of high-grade repetition grey iron, semi-steel, gun-metal and brass, etc., castings throughout the Midlands and South of England (including London area), by well-known makers of light engineering lines having a considerable surplus foundry output for disposal at competitive prices.—Applicants should state age, experience, ground previously covered, and expectations as regards terms, to Box 986, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

PROPERTY—*Continued.*

SPACIOUS WORKSHOPS to Let, suitable for ironworks or motor-works; now empty.—Write, BOOTH, King Street, Belper.

PATENT.

THE Owner of British Patent No. 304302, relating to "Improvements in Ingot Moulds," is desirous of entering into negotiations for the grant of Licences or otherwise, under suitable terms, for the purpose of exploiting the invention and ensuring its full development and practical working in this country.—For particulars, address, ARTHUR SADLER, 44, Waterloo Street, Birmingham.

MACHINERY.

FOR SALE, as new, cheap. Tilghman's Sand Blast Plant. Type V.I. Complete, suitable for ordinary requirements. Vertical Tilghman's Compressor. Air Receiver and Exhausting Fan and Accessories.—OUZLEDALE FOUNDRY COMPANY, Barnoldswick.

BONVILLAIN & RONCERAY Universal Roll-over MOULDING MACHINE, hydraulic squeeze, type R.C.1, complete with Down Sand Frame Equipment.
Maximum available height under ram, 3 ft. 6 in.
Dimensions of table, 4 ft. 11 in. x 3 ft. 10½ in.
Distance between columns, 3 ft. 10½ in.
Stroke of ramming piston, 1 ft. 4½ in.
Pressure required for operation, 750 lbs. per sq. in.
The machine is complete with vertical type accumulator complete with all necessary valves, couplings, piping, etc., to make a self-contained unit of plant. The complete plant is in excellent condition and has been very little used. It was installed in 1927 and cost, ex maker's works and exclusive of installation expenses, £963.

OFFERS ARE INVITED.

"Adaptable" MOULDING MACHINE, No. 1802, to take 17 x 15 boxes. £20.

"Denby" JOLT MOULDING MACHINE, hand-operated, 24-in. square plate. £25.

One CUPOLA, 19 ft. high x 2 ft. 6 in. dia., to deliver 3 tons of metal per hr., complete with 90 new furnace bricks, and complete with "Cyclone" fan. £50.

"Adaptable" Portable Electric RIDDLE, 18½ in. dia., with ¼-h.p. motor, 220 volts D.C. £12 10s.

Several Geared LADLES, 30-cwt., 20-cwt. and 8-cwt. capacity. Offers invited.

Portable Beam Type PLATFORM SCALE, to weigh up to 2¼ cwts. Offers invited.

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Four- and Six-wheel LOCOMOTIVES, from 10-in. to 16-in. dia. cylinders; available for SALE or HIRE.

Six nearly new Nissen-type STEEL BUILDINGS, each about 550 ft. long x 40-ft. span x 19 ft. 10 in. high in centre of bay. Prices and full details on application.

(ASK FOR "ALBION" MACHINERY CATALOGUE.)

ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued.*

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MISCELLANEOUS.

CUT DOWN COSTS 25 per cent. by using S.M. Patent Heating Coke; graded to meet all requirements.—Inquiries to STANDARD MINERALS COMPANY, Dept. 11, Bilbie Street, Nottingham.

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250 TONS of good Cast Scrap Iron, free from burnt, for Sale. What offers?—H. J. GASSON & SONS, Government Contractors, Rye. 'Phone, Rye 34.

'Phone: 287 SLOUGH

LADLES—GEARED

12-Ton "Stevenson"	... ...	£48
9-Ton "MacNeil"	... ...	£42
6-Ton "Thwaites"	... ...	£34
4-Ton "Evans"	... ...	£28
2-Ton "Evans"	... ...	£19

SAND PLANT

3 ft. 6 in. "Evans" Sandmill		£15
"Jackman" SM4 Aerator	...	£12
"Herbert" sand whizzer	...	£32
"Jackman" Rotary Sifter	...	£8

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
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A new range of compositions containing varying proportions of Nickel, Chromium, Vanadium, Titanium, etc., suitable for wear and corrosion resistance, castings required to withstand high temperature, acid resistance and for high strength, toughness and resilience qualities. The use of Alloy Pig Irons ensures homogeneous castings, avoids segregation and ladle losses and gives 100% benefit from alloy additions.

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